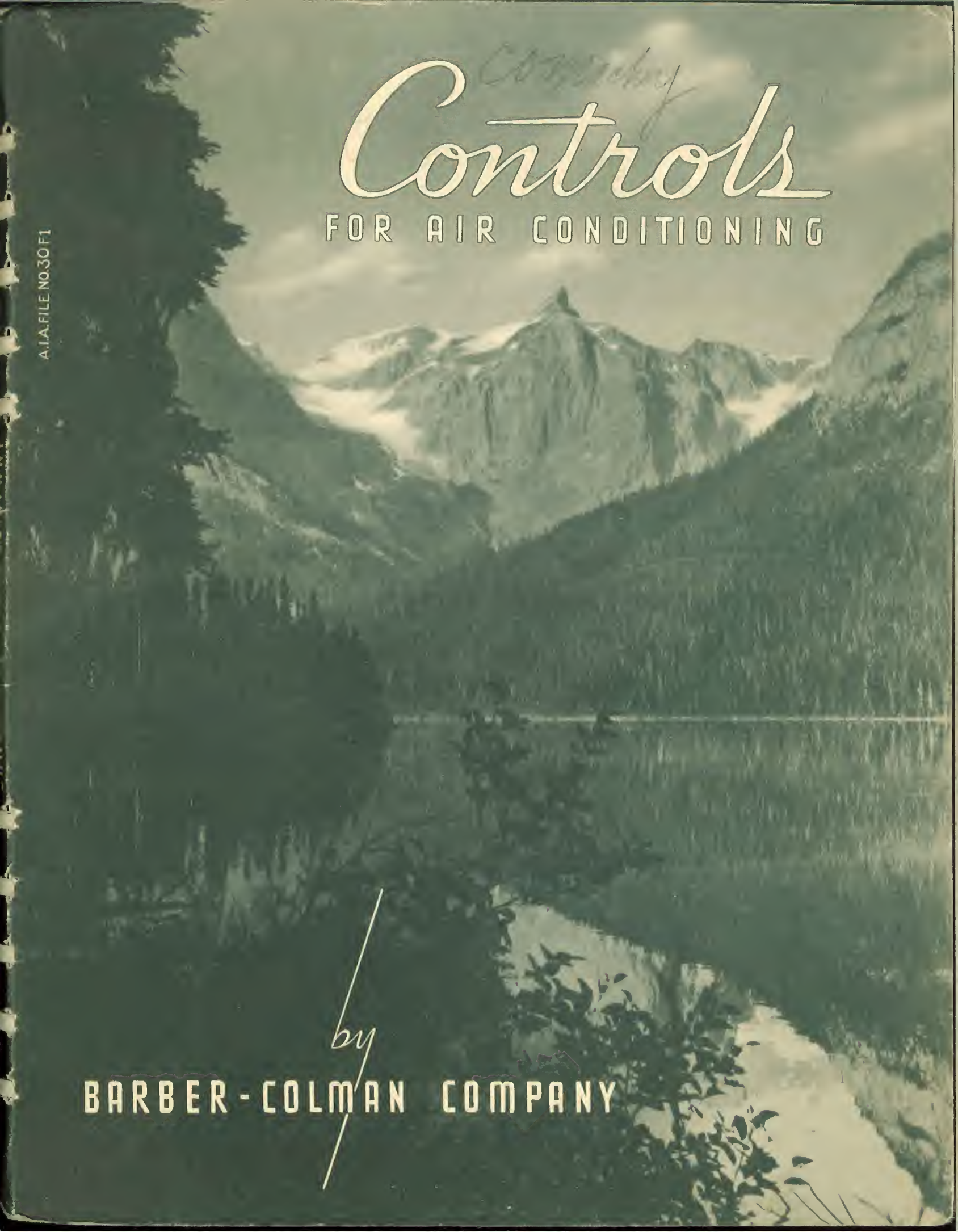
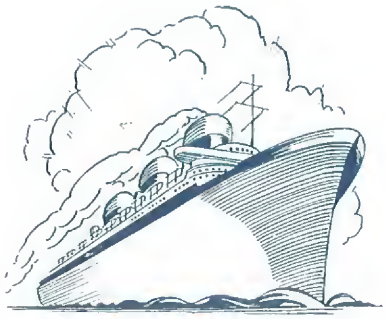

Controls
FOR AIR CONDITIONING
A.I.A. FILE NO. 30 F 1
by
BARBER-COLMAN COMPANY

THIS book has been prepared to describe and explain the controls and control applications for various types of Air Conditioning Systems. It is not intended to favor or discuss the relative merits of the many types of systems or manufactured units except with respect to the control applications.

Cover.
Emerald Lake and Mt. President,
Yoho National Park, B. C., Canada.
Courtesy—Canadian Pacific Railway.



FOREWORD

THE successful operation of any Air Conditioning System depends upon the proper designing, planning, selection of controls and installation of the equipment. Therefore, this responsibility should be placed in the hands of responsible and capable parties. The architect, engineer or contractor will make the proper selection of the system or units and controls, taking into consideration local conditions, the accuracy of control required, and the amount of money available for the installation.

BARBER-COLMAN COMPANY manufacturers a complete line of electrically operated temperature and humidity control equipment. The flexibility of the Electric System makes it possible for BARBER-COLMAN controls to be adapted to, and to give the best possible control of, any type of Air Conditioning System or manufactured unit.

Some types of Air Conditioning Systems are patented. BARBER-COLMAN COMPANY cannot assume responsibility on account of infringement of patents covering these systems as distinguished from the controls therefor.

BARBER-COLMAN COMPANY maintains branch offices, or has distributors and sales representatives in practically every part of the country. (See last page.) The engineers in these organizations are glad to recommend, or assist in the selection of, proper controls for any type of installation.

Other literature is available which describes the application of BARBER-COLMAN electric controls to a great variety of heating systems and industrial installations. Temperature, pressure, humidity, and the flow of gases or liquids can be regulated or controlled, within any desired range, either automatically or by manually operated switches from a remote point.

BARBER-COLMAN CONTROL EQUIPMENT IS LISTED AS STANDARD BY THE UNDERWRITERS' LABORATORIES

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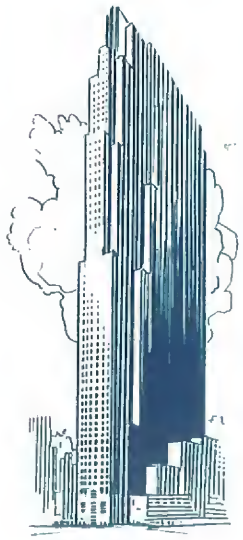
INTRODUCTION



IT is a proven fact that an Air Conditioning System properly installed will produce more healthful and comfortable conditions in the home or office, and result in increased economy and business activity in commercial installations. It is also a recognized fact that the proper functioning of any installation is definitely dependent on the controls. Therefore, too much emphasis cannot be placed on the importance of selecting the proper control equipment.

The following is arranged for convenience in selecting the proper controls, and will serve as a "yardstick" in making comparisons:

The Manufacturer of the controls should:

Be financially responsible.

Have an unquestionable reputation of fair dealing.

Have a sales and service organization large enough to cover the locality in which the controls are installed.

Have a record of satisfactory Temperature Control installations.

Have an Engineering Department which actually functions to keep up with the rapid progress being made in the Air Conditioning field.

The Control Equipment should be:

Designed with consideration for appearance, as well as performance.

As nearly mechanically perfect as is practical.

Precision built to insure long, continuous, and dependable service.

Easy to install and service or to replace if necessary on account of accidental damage.

Economical in operation and maintenance.

As simple and fool-proof as possible and require the minimum number of accessories.

Ready for instant service at all times, even after long shutdown periods.

The selection of controls should be such that they will:

Maintain the temperature in the controlled space within the specified limits.

Prevent delivery of hot or cold blasts of air to the conditioned space.

Prevent freezing of steam or water coils.

Operate the controlled equipment with the greatest possible economy.

BARBER-COLMAN COMPANY and BARBER-COLMAN CONTROLS meet every one of the above requirements.

BARBER-COLMAN COMPANY was established in 1900, and has grown steadily ever since. The Company has an enviable reputation and the highest financial rating.

The TEXTILE MACHINERY DIVISION, established in 1900, manufacturers:

Automatic Spoolers and Super-Speed Warpers
Warp Tying and Warp Drawing Machines
Hand Knotters
Ball Warpers
Twister Creels

Some of these products are found in practically every cotton, silk and rayon mill in the United States and in many foreign countries.

The MACHINE AND SMALL TOOL DIVISION, established in 1908, manufacturers:

Hobs—Milling Cutters—Reamers
Hobbing Machines—Hob and Reamer Sharpening Machines
Special Tools and Machinery

Most of these products are used by practically every automobile and airplane manufacturer in the world. The hobs, milling cutters and reamers are being used wherever production requires precision tools.

THE ELECTRICAL DIVISION, established in 1926, manufacturers:

Electrically Operated Temperature and Humidity Control Equipment
Uni-Flo Grilles and Registers
The Barcol OVERdoor
Electric Door Operators
Radio Control for Garage Doors
Barcol Electric Fans
Barcol Midget Electric Motors

These products all stand at the head of their respective classes, and like other BARBER-COLMAN products, may be found in all parts of the world.

The discussion in this book has been arranged in separate Parts, each Part covering the control of a different type or phase of an Air Conditioning System. Each Part starts with a simple form, the system being developed or elaborated upon as the discussion proceeds. This arrangement permits a better understanding of the functioning and value of the control equipment, and will assist in selecting the control system best suited to the requirements of any particular installation.

No attempt is made to cover all of the possible control combinations, but the discussion of the control of the various units is arranged in such a way that it will be easy to substitute one type of control for another, to meet some particular requirements; e. g., the control of the Reheater described in Control System 101 could be easily substituted for the Reheater Control described in Control System 108, provided such substitution will meet the requirements of the particular system under consideration. It is not recommended that one should make promiscuous substitutions merely for the sake of an initial saving, as it has been found that in most cases the combinations described in this book will give the greatest economy of operation for the particular type of system.

DESCRIPTION OF CONTROLS

The following is only a brief description of the controls used in the Air Conditioning Systems illustrated in this book. More detailed and technical information regarding these controls will be found in the data sheets under Part IX.

THERMOSTATS

Room Thermostats may be had in a number of types—Single Temperature, Two-Temperature, Duplex, and Microtherm (proportioning type). In order to be best suited to the particular application, the Thermostat may be selected with internal or external adjustment, with or without detents, with or without lock cover, and with or without thermometer.

"Detents", small permanent magnets, are available in most types. They provide snap action movement of the tongue from one contact to the other, and prevent "chattering". They also permit the use of the Thermostat in 2-wire, as well as 3-wire circuits.

The bakelite cases of all Room Thermostats blend harmoniously with any surroundings, or if desired they may be finished to contrast with any color scheme, or to match the walls on which they are installed. The BARBER-COLMAN ELECTRIC SYSTEM permits the simplest possible construction of the Thermostat, with the result that the extreme accuracy of the instruments can be relied upon indefinitely.

Single Temperature Thermostats are used for wall mounting in spaces which are to be maintained at usual room temperatures. See data sheet T-10.

Two-Temperature Thermostats are used where it is desired to maintain one temperature for part of the time, and a different temperature for the rest of the time without changing the setting of the Thermostat, e.g., Day and Night, or Summer and Winter control. The mechanism consists of two separate thermostatic elements and a magnetic shifting device within one case. The control may be shifted from one element to the other by using the lever at the top of the case, or it may be shifted on a number of Thermostats simultaneously by an automatic time switch (or manually operated switch) from a remote point. See data sheet T-10.

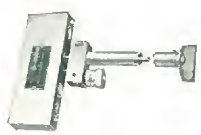
Duplex Thermostats are similar to Two-Temperature Thermostats except they do not have the magnetic shifting mechanism. These Thermostats may be used to control two separate units of heating equipment or heating and cooling equipment; e.g., one element may be set at 72 F to control the heating equipment, and the other element set at 78 F to control the cooling equipment. They may also be used to control the same equipment at two different temperatures, or to reverse the operation of the equipment for Summer and Winter use. The control circuit may be shifted from one element to the other by an automatic time switch (or manually operated switch) from a remote point. See data sheet T-10.

Microtherm, a proportioning type thermostat, is one of the latest developments of Barber-Colman engineers for the control of Modulating Valves or Dampers. It solves the problem of control of room temperatures where the heating mechanism causes a high rate of change of room temperature, but where the air circulation, and therefore response of the thermostat, is relatively slow; e.g., a Unit Ventilator controlled from a room type thermostat; chilled water supply controlled from an immersion, or room type thermostat; reheater coil controlled from a room or duct type thermostat installed in the return air duct. Microtherm is always used in combination with Microtrol (modulating damper control motor) or Microvalve (modulating motor-operated valve). This system gives very accurate control, and eliminates overrun because the controlled device is rapidly and definitely positioned for each different temperature at the Microtherm. See data sheet T-10.

Insertion and Immersion Thermostats have their sensitive elements arranged so that they may be inserted into the path of air, or immersed in the liquid to be controlled.

A perforated tube guard is furnished to protect the element when the Thermostat is to be used in a duct, or a closed tube guard for immersion in liquids or when it is to be exposed to excessive moisture or corrosive vapors.

The case enclosing the contacts is made of bakelite, and all contacts and electrical connections are on the outside of the duct or pipe. The Thermostats are made with either internal or external adjusting lever. See data sheet T-10.



Air Stream Thermostats have a long tubular sensitive element which may be obtained in various lengths so that when installed the sensitive element will extend across the entire duct. Thus an Air Stream Thermostat controls from the *average* temperature across the duct. It is important that this type of Thermostat be used where indicated in the following control systems. See data sheet T-10.

Thermostatic Adjuster, a recent development of Barber-Colman engineers, is particularly adapted to air conditioning control applications where it is desired to vary indoor temperatures in accordance with outdoor temperature changes. Its use permits the maintaining of the most desirable indoor temperatures in Summer, thus avoiding the unpleasant effect of entering or leaving a conditioned space in which the temperature is uncomfortably low as compared with the outdoor temperature. See data sheet T-10.

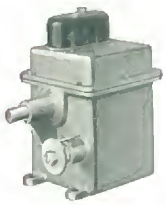
HYGROSTATS

Hygrostats are obtainable for either wall mounting, or installation in a duct. The sensitive element of these instruments consists of a large number of human hairs, each hair being separately mounted, tensioned, and ventilated. These instruments have proven to be very sensitive, dependable, and particularly adaptable to the control of humidity in Air Conditioning Systems. See data sheet H-10.

DAMPER CONTROL MOTORS

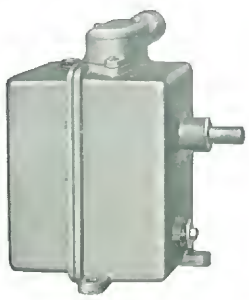
Damper Control Motors are made in three types, and in a variety of sizes of each type. Each Damper Control Motor is powered by the BARCOL shaded pole induction motor, which has only one moving part, and requires no attention except occasional oiling. The oil-immersed models require no attention.

Stall Type or spring return Damper Control Motors are constructed so as to run in one direction to a stalled position when the power is on; and return in the opposite direction by means of an external spring or weight when the power is interrupted. In Air Conditioning applications this type is particularly well suited to small fresh air dampers (10 sq. ft. or less) when it is desired to open the damper to one position when the fan is on, and to close the damper when the fan is stopped. See data sheet DC-10.



Unidirectional Type Damper Control Motors operate in one direction only. The number and position of intermediate stops, and the desired cam arrangement are determined by the selection of the proper Damper Control Motor (see data sheet DC-10). All Damper Control Motors, except Group DC-100, are equipped with auxiliary cam-operated switches so that additional equipment may be operated automatically at definite positions of the damper.

These Damper Control Motors, with the exception of Group DC-100, are furnished either with or without an adjustable speed mechanism, and are made in various sizes. The BARCOL motor, cam-operated switches, and gear train are immersed in oil and enclosed in a die cast case, eliminating even the necessity of oiling. See data sheet DC-10.



Reversible Type Modulating Damper Control Motors operate in either direction; may be stopped in any intermediate position and restarted in either direction.

These Damper Control Motors are also immersed in oil, enclosed in oil-tight die cast cases and made in various sizes. They can be furnished with a speed adjusting mechanism, allowing the speed of operation of each damper to be adjusted, on the job, so that it will be best suited to the function it has to perform in the Air Conditioning System. See data sheet DC-10.

Microtrol is the modulating Damper Control Motor used in conjunction with Microtherm. It is similar to the other Reversible type Damper Control Motors, but has in addition, an internal potential-dividing rheostat driven from the same BARCOL Motor that drives the power output shaft. The construction is exceedingly simple and rugged. The combination of Microtherm and Microtrol will give more accurate modulating control of room temperatures than has heretofore been obtainable except by use of very delicate laboratory instruments. See data sheet DC-10.

It may be a little difficult to determine when to use the Unidirectional type or Reversible type Damper Control Motor, so a few examples may help in selecting the proper type.

1. If the operation of a damper is such that it is to be either open or closed, the Unidirectional type may be used. It may be connected through suitable linkage or connected directly to the damper if the damper is free to turn in the same direction through alternate open and closed positions.

2. If a damper is required to position itself at intermediate points in order to maintain a constant temperature in the plenum, then the Reversible type should be used.

3. If it is desired to regulate the position of the fresh air damper from a manually operated switch so that the damper may be placed in, or changed to, any one of a number of fixed positions, then either type could be used, although the Reversible type is preferable. For example, if the damper is operated from a 5-point switch, and has run from the closed position to No. 3 position, and then it is desired to return the damper to No. 2 position, the Unidirectional type would continue in the same direction from No. 3 through No. 4, No. 5 and No. 1 positions before stopping on No. 2 position; whereas, with the Reversible type the position of the damper would change directly from No. 3 to No. 2 position. Naturally the Reversible type would give more rapid response. In most cases, the Unidirectional type must be connected to the damper through proper linkage, whereas with the Reversible type, linkage may be used or it may be connected directly through a coupling to the extended shaft of the damper.

4. The Reversible type should be used on all face and by-pass, or other types of dampers where throttling or modulating operation is required.

5. If a Damper Control Motor of the oil-immersed type is to be installed within the fresh air duct, or any place where it would be exposed to sub-zero temperatures for long periods, the Reversible type should be used if rapid response is required. At continued low temperatures the oil in the Unidirectional type may become so viscous that the speed of operation will be reduced.

MOTOR-OPERATED VALVES

Motor-Operated Valves are made in sizes from ½" to 16" in standard valve body patterns and the following types: packless, single disc packed, semi-balanced, full-balanced, pilot piston, three-way, four-way and butterfly. The type and size of the valve body will of course be determined by the particular application. See data sheets V-10 to V-100 inclusive for dimensions and technical information. A motor-driven mechanism, or Valve Operator, is available in both the Positive (Unidirectional) and Throttling (Reversible) type.

All operators are powered with the BARCOL shaded pole induction motor. All Valve Operators are enclosed within a bakelite or metal cover. The oil-immersed Valve Operators have the operating mechanism enclosed within a die cast case similar to the Damper Control Motors.

Positive Type Valves operate only to the open and closed positions.

Throttling Type Valves can be operated in either direction and stopped at, or started from, any intermediate position. The oil-immersed Valve Operators of either the Positive or Throttling type, are obtainable either with or without an adjustable speed mechanism so that the speed of operation of the Valve may be exactly suited to the individual installation to give the best results. Also both types may be equipped with auxiliary cam-operated switches so that additional equipment may be operated automatically at definite predetermined positions of the Valve. The application of these auxiliary switches will be explained later, as they are used in the circuits outlined for the control of various Air Conditioning Systems.

Microvalve, always used in conjunction with the Microtherm, is a Throttling type Valve Operator embodying a mechanism similar to the Microtrol. The Microvalve with the Microtherm makes rapid corrections for changes in load, has hundreds of equilibrium control positions, and moves to the exact position required with almost uncanny precision.

The following examples may help to determine when to use Positive or Throttling type Motor-Operated Valves.

1. A Positive Valve should be used on a steam coil that is located directly in the fresh air intake, the Valve being controlled by a Thermostat in such a way that it will open, and remain open whenever the outdoor temperature is 35 F or below. This gives protection against freezing. If there is a second coil in the fresh air duct, a Throttling Valve should be used on this second coil, in order to give the most accurate control. There would be no possibility of freezing the condensate in this coil because the air would be tempered by the first coil.

2. Preheater coils located in the return air duct, and usually all reheater coils should be operated by Throttling Valves. These coils naturally must be of sufficient capacity to take care of the heating requirements under minimum outdoor temperatures; therefore, in mild weather, Positive Valves would give unsatisfactory control because of the rapid temperature rise each time the Valve opened, causing blasts of hot air. A Positive Valve would result in overheating also, because of the greater amount of steam admitted each time there was a call for heat.

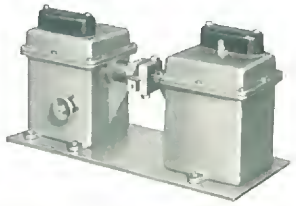
3. In most cases, when controlled by a Room Thermostat, cooling coils can be operated by Positive Valves without disagreeable overrun. The reason for this is that rooms do not respond as rapidly to cooling as they do to heating, because cooling coils usually do not have as much capacity in comparison to the demand, as do heating coils.

4. If the cooling coils were controlled from a Duct Thermostat in the fan discharge, a Positive Valve would operate very frequently and cause cold drafts; therefore, a Throttling type Valve should be used as it will give more even control, and greater economy.

SOLENOID VALVES

Solenoid Valves may be had in sizes from ¼" to ¾", for use with gas, water, or refrigerants. These Valves open when current is applied, and close by gravity and pressure when the current is cut off. See data sheet V-120 for complete information and specifications.

PROGRAM SWITCHES



Program Switches are motor-driven, contact-making mechanisms. They are available in a number of standard combinations, and may be built to order, to give any special operating sequence.

They may be used for shifting groups of Two-Temperature Thermostats at definite intervals; for controlling the operation of Solenoid Valves, relays, Motor-Operated Valves, or compressors, in such a manner that they will open in any sequence with definite time intervals, and close in the same or reverse sequence. See data sheet DC-10 for specifications.

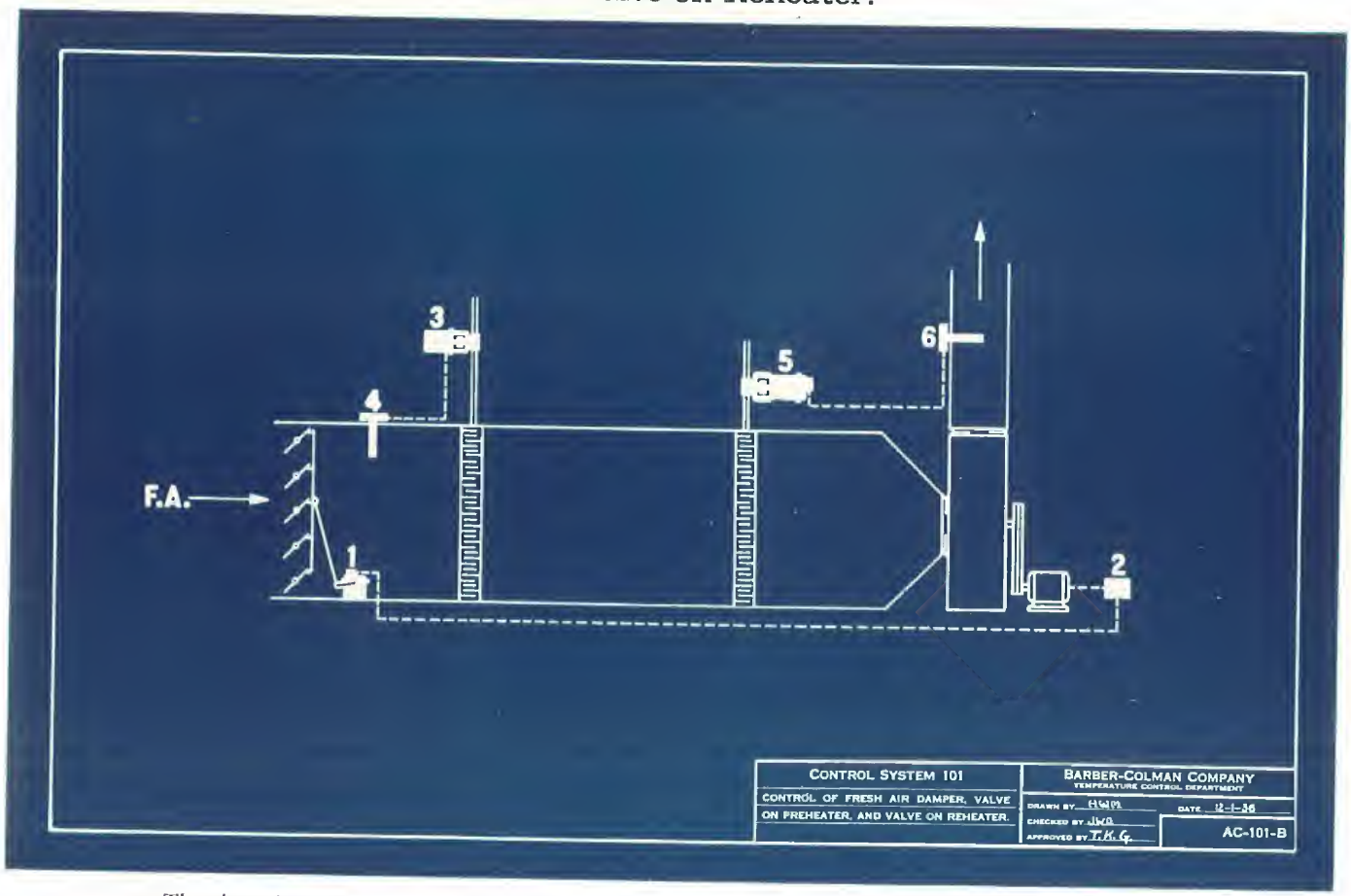
ACCESSORIES

It is important to bear in mind that with a BARCOL Electric System of Temperature Control a transformer is usually required to reduce the line voltage, as most BARBER-COLMAN Controls operate from 22½ volt alternating current. Because of the low voltage employed, the expense of the electrical installation of the BARBER-COLMAN System is reduced to the minimum.

A complete description of accessories such as overload breakers, electric time switches, damper crank arms, linkage, etc., will be found in data sheet A-10.

CONTROL SYSTEM 101

Control of Fresh Air Damper, Valve on Preheater, and Valve on Reheater.



The above layout represents a Ventilating System employing the minimum of equipment and controls.

Controls	Data Sheet
1. Unidirectional Damper Control Motor, Group DC-200	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Positive Valve	V-20 or V-40
4. Insertion Thermostat fYDj 103	T-10
5. Throttling Valve	V-80
6. Insertion Thermostat fYDj 104	T-10

DESCRIPTION OF OPERATION

Fresh Air Damper Control. Relay (2) controls Damper Control Motor (1), which in turn operates the Fresh Air Damper in such a manner that when the fan is running the damper is open, and when the fan is stopped the damper is closed. Automatic closing of the damper prevents cold air reaching the tempering coils, and possible damage due to freezing when the system is not in operation.

Preheater Control. Thermostat (4) set at 35 F opens Positive Valve (3), admitting steam to the Preheater, whenever the outdoor temperature drops below 35 F, thus avoiding a possibility of freezing in the coils.

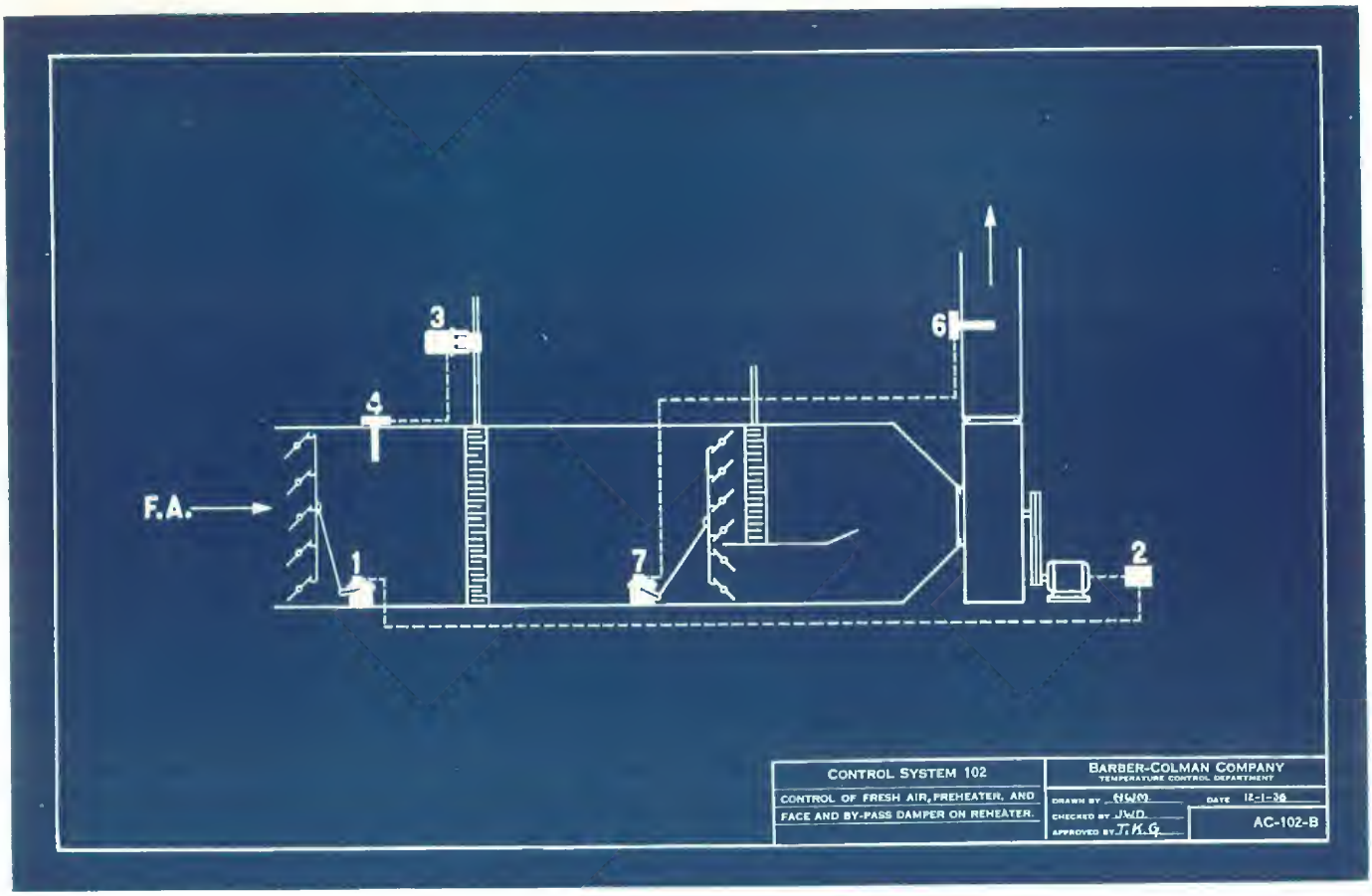
Reheater Control. Thermostat (6) set at 70 F, operates Throttling Valve (5) on steam line to the Reheater to maintain a constant temperature of the air leaving the system.

Upon call for heat, Valve starts to open, and continues opening until Thermostat (6) is satisfied, or until the full open position is reached if the demand for heating persists. Valve will stop and remain in any position whenever, and as long as, Thermostat is satisfied; it may be restarted in either direction to satisfy the demands for more or less heat. Upon call for cooling, the reverse action takes place, Valve closing until Thermostat (6) is satisfied, or until the full closed position is reached.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 102

Control of Fresh Air Damper, Valve on Preheater, and Face and By-pass Damper on Reheater.



The above layout represents a Ventilating System similar to that described in Control System 101, except the Face and By-pass Damper replaces Steam Valve on Reheater.

Controls	Data Sheet
1. Unidirectional Damper Control Motor, Group DC-200	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Positive Valve	V-20 or V-40
4. Insertion Thermostat fYDj 103	T-10
6. Insertion Thermostat fYDj 104	T-10
7. Reversible Damper Control Motor, Group DC-500, Adj. Speed	DC-10

DESCRIPTION OF OPERATION

Fresh Air Damper Control. Relay (2) controls Damper Control Motor (1), which in turn operates the Fresh Air Damper in such a manner that when the fan is running the damper is open, and when the fan is stopped the damper is closed. Automatic closing of the damper prevents cold air reaching the tempering coils, and possible damage due to freezing when the system is not in operation.

Preheater Control. Thermostat (4) set at 35 F opens Positive Valve (3), admitting steam to the Preheater, whenever the outdoor temperature drops below 35 F; thus avoiding a possibility of freezing in the coils.

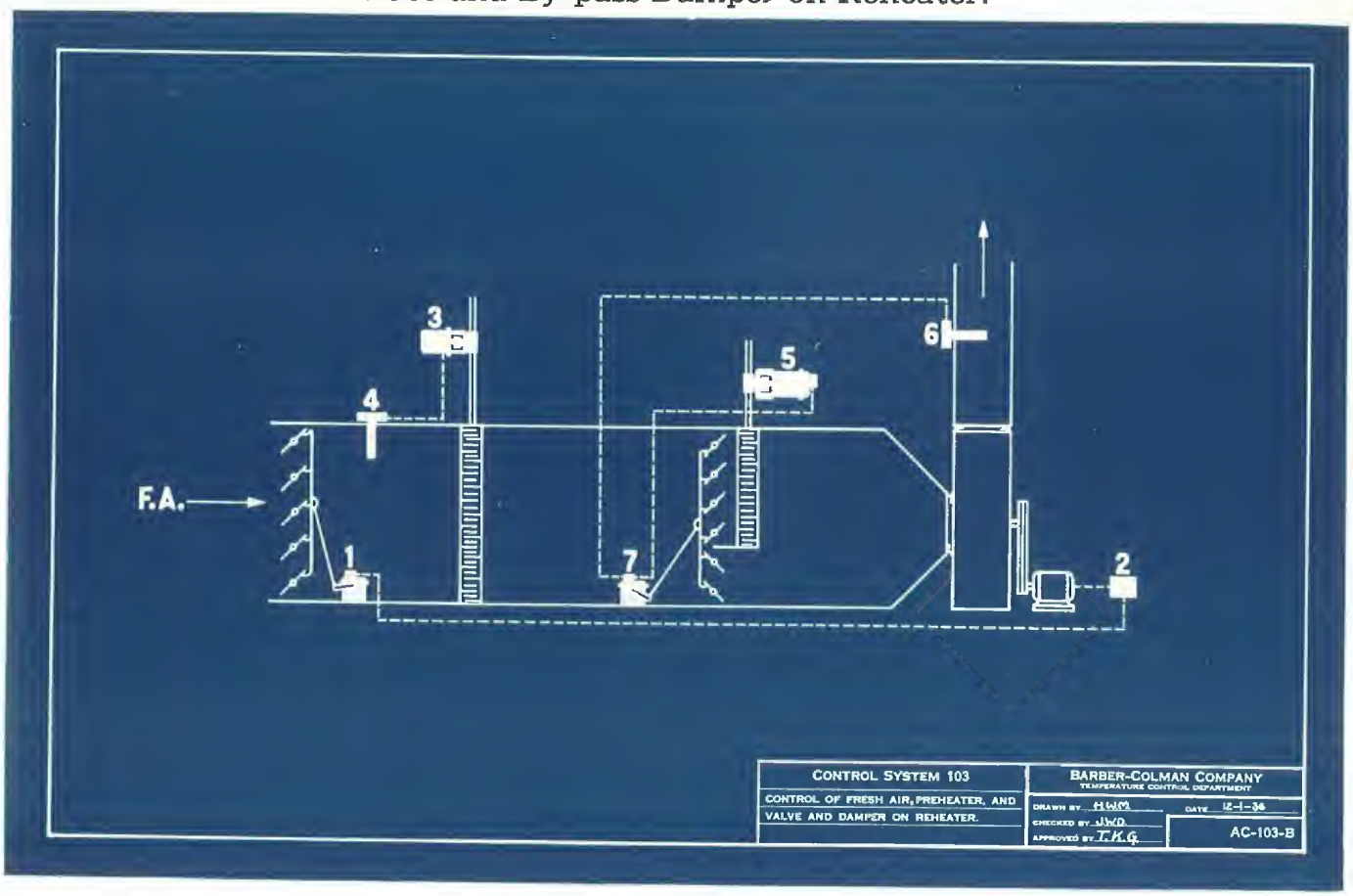
Reheater Control. Thermostat (6) set at 70 F, operates Reversible Damper Control Motor (7), which in turn operates the Face and By-pass Damper to maintain a constant temperature of the air leaving the system. This is accomplished by regulating the amount of air by-passed under the coil and that passed through the coil. Upon continued demands for heat, all air is directed through the coil; upon continued demands for cooling all air is directed under the coil through the by-pass. In intermediate positions accurate proportioning is obtained. The adjustable speed mechanism makes it possible to regulate the dampers, on the job, for a speed best suited to each individual installation.

As there is no control on the steam line to Reheater, there of course is possibility of overheating. It has been found that overheating is reduced to a minimum by extending the by-pass beyond the heating coil for a distance equal, at least, to the height of the by-pass.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 103

Control of Fresh Air Damper, Valve on Preheater, Valve on Reheater, and Face and By-pass Damper on Reheater.



The above layout represents a Ventilating System similar to that described in Control System 102, except for the addition of Valve on Reheater Coil.

Controls	Data Sheet
1. Unidirectional Damper Control Motor, Group DC-200	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Positive Valve	V-20 or V-40
4. Insertion Thermostat, fYDj 103	T-10
5. Throttling Valve	V-20, V-40 or V-80
6. Insertion Thermostat, fYDj 104	T-10
7. Reversible Damper Control Motor, Group DC-500, Cams A, Adj. Speed	DC-10

DESCRIPTION OF OPERATION

Fresh Air Damper Control. Relay (2) controls Damper Control Motor (1), which in turn operates the Fresh Air Damper in such a manner that when the fan is running the damper is open, and when the fan is stopped the damper is closed. Automatic closing of the damper prevents cold air reaching the tempering coils, and possible damage due to freezing when the system is not in operation.

Preheater Control. Thermostat (4) set at 35 F opens Positive Valve (3), admitting steam to the Preheater whenever the outdoor temperature drops below 35 F; thus avoiding a possibility of freezing in the coils.

Reheater Control. Thermostat (6) set at 70 F, operates Reversible Damper Control Motor (7), which in turn operates the Face and By-pass Damper to maintain a constant temperature of the air leaving the system. The operation of Throttling Valve (5) on the steam line is controlled from the auxiliary switches in Damper Control Motor (7). Damper Control Motor (7) always regulates the temperature as far as possible by the operation of the Face and By-pass Dampers; Valve (5) operates only when necessary to supply more or less heat after the Face and By-pass Damper has reached its maximum heating or cooling position.

Upon call for heat Damper Control Motor (7) starts to open Face Damper and to close By-pass Damper. If the demand for heat continues after damper has reached the maximum heating position (By-pass closed, Face Damper open) then Throttling Valve (5) starts to open and continues to open until Thermostat (6) is satisfied.

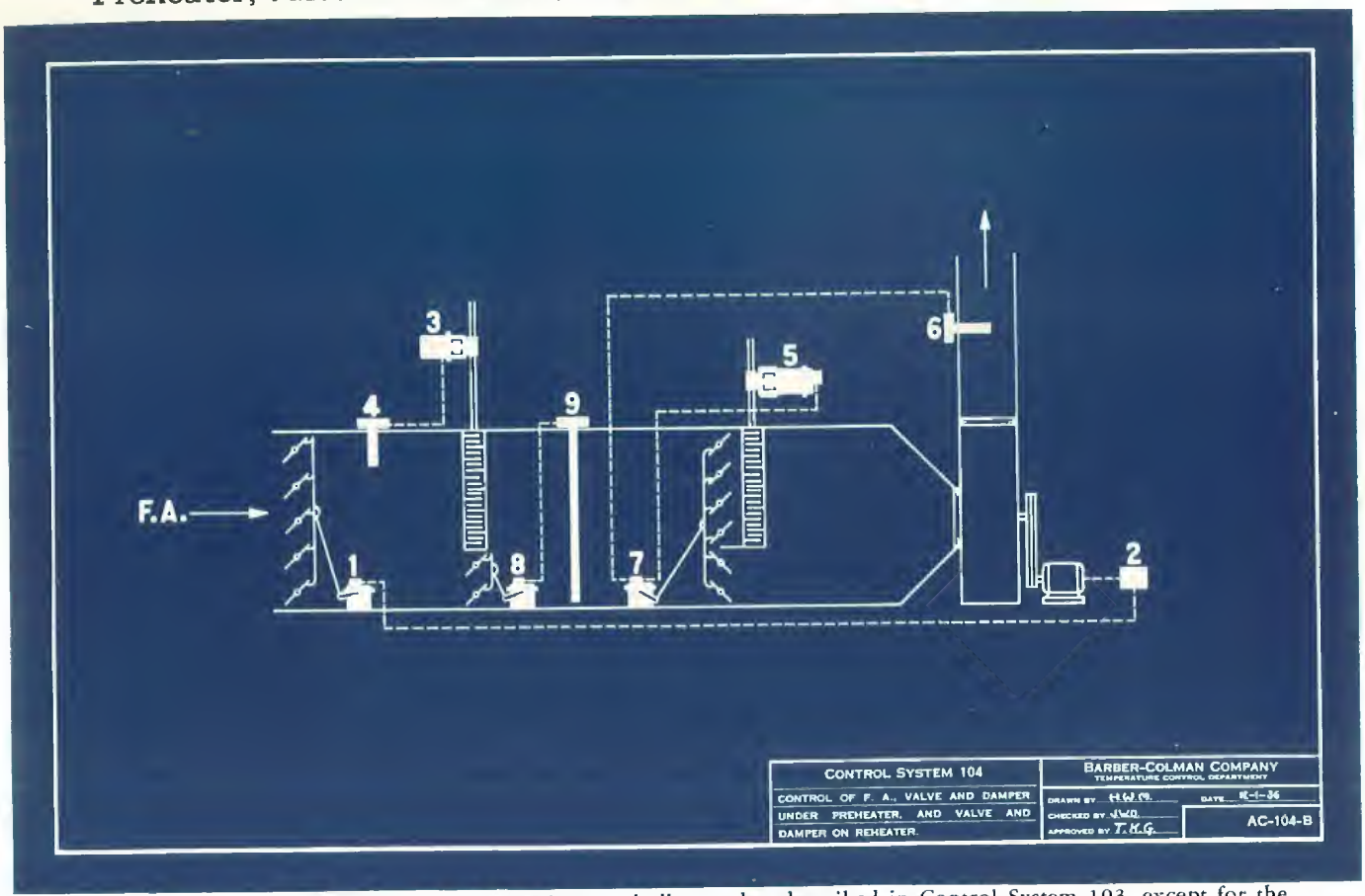
Upon call for less heat Throttling Valve (5) does not change its position, the cooling being accomplished by Damper Control Motor (7) regulating the Face and By-pass Damper. However, when Face and By-pass Damper reaches the full cooling position (By-pass open, Face closed) and there is demand for additional cooling, then Throttling Valve (5) starts to close, and continues to close until Thermostat (6) is satisfied.

The adjustable speed mechanism on both Damper Control Motor (7) and Throttling Valve (5) makes it possible to regulate the dampers and Valve, on the job, for a speed best suited to each individual installation.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 104

Control of Fresh Air Damper, Valve on Preheater, By-pass Damper under Preheater, Valve on Reheater, and Face and By-pass Damper on Reheater.



The above layout represents a Ventilating System similar to that described in Control System 103, except for the addition of the By-pass Damper under the Preheater.

Controls	Data Sheet
1. Unidirectional Damper Control Motor, Group DC-200	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1, or 31	A-10
3. Positive Valve	V-20 or V-40
4. Insertion Thermostat, fYDj 103	T-10
5. Throttling Valve	V-20, V-40 or V-80
6. Insertion Thermostat, fYDj 104	T-10
7. Reversible Damper Control Motor, Group DC-500, Cams A, Adj. Speed	DC-10
8. Reversible Damper Control Motor, Group DC-500, Adj. Speed	DC-10
9. Air Stream Thermostat	T-10

DESCRIPTION OF OPERATION

Fresh Air Damper Control. Relay (2) controls Damper Control Motor (1), which in turn operates the Fresh Air Damper in such a manner that when the fan is running the damper is open, and when the fan is stopped the damper is closed. Automatic closing of the damper prevents cold air reaching the tempering coils, and possible damage due to freezing when the system is not in operation.

Preheater Control. Thermostat (4) set at 35 F opens Positive Valve (3), admitting steam to the Preheater whenever the outdoor temperature drops below 35 F; thus avoiding a possibility of freezing in the coils.

By-pass Control. Air Stream Thermostat (9) is installed so that the sensitive element is in contact with the air coming through the by-pass, as well as with that coming through the coils. It is set at 40 F and operates Reversible Damper Control Motor (8), which in turn operates the By-pass Damper. This control eliminates overheating in mild weather, when Valve (3) is open and the outdoor temperature is only slightly below 35 F, by by-passing Fresh Air under the Preheater. The adjustable speed mechanism on Damper Control Motor (8) makes it possible to regulate the damper, on the job, for a speed best suited for each individual installation.

CONTROL SYSTEM 104—Continued

Reheater Control. Thermostat (6) set at 70 F, operates Reversible Damper Control Motor (7), which in turn operates the Face and By-pass Damper on the reheater coil to maintain a constant temperature of the air leaving the system. The operation of Throttling Valve (5) on the steam line is controlled from the auxiliary switches in Damper Control Motor (7). Damper Control Motor (7) always regulates the temperature as far as possible by the operation of the Face and By-pass Dampers; Valve (5) operates only when necessary to supply more or less heat after the Face and By-pass Damper has reached its maximum heating or cooling position.

Upon call for heat Damper Control Motor (7) starts to open Face Damper and to close By-pass Damper. If the demand for heat continues after damper has reached the maximum heating position (By-pass closed, Face Damper open) then Throttling Valve (5) starts to open and continues to open until Thermostat (6) is satisfied.

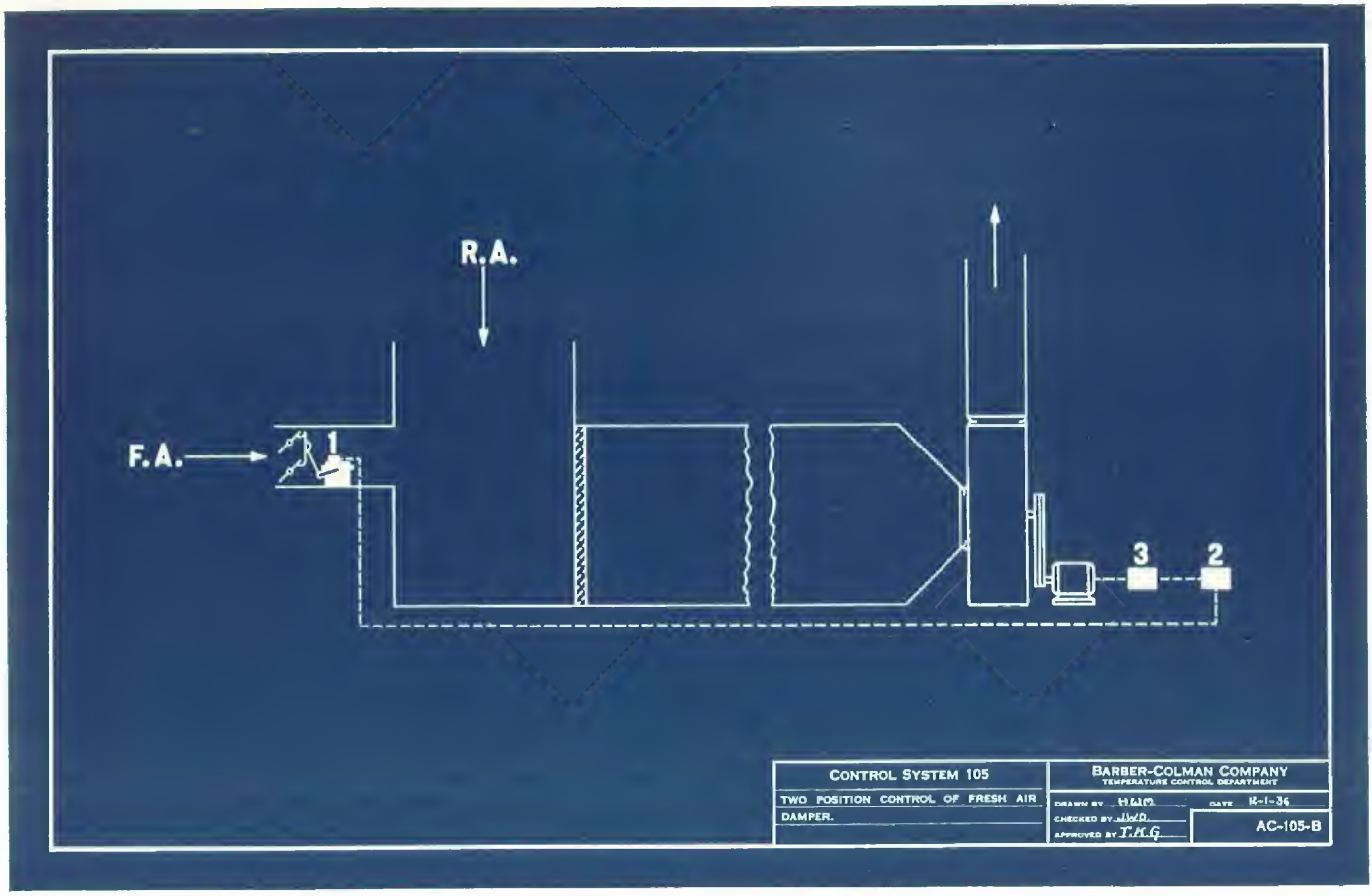
Upon call for less heat Throttling Valve (5) does not change its position, the cooling being accomplished by Damper Control Motor (7) regulating the Face and By-pass Damper. However, when Face and By-pass Damper reaches the full cooling position (By-pass open, Face closed) and there is demand for additional cooling, then Throttling Valve (5) starts to close, and continues to close until Thermostat (6) is satisfied.

The adjustable speed mechanism on both Damper Control Motor (7) and Throttling Valve (5) makes it possible to regulate the dampers and Valve, on the job, for a speed best suited to each individual installation.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 105

Two-Position Control of Fresh Air Damper.



The above layout illustrates a simple control for Fresh Air, with no control on Recirculated Air.

Controls	Data Sheet
1. Unidirectional Damper Control Motor, Group DC-200	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Single Pole, Double Throw Switch, sYZe 3 or 4	A-10

DESCRIPTION OF OPERATION

Fresh Air Damper Control. Relay (2) controls Damper Control Motor (1), which in turn operates the Fresh Air Damper in such a manner that when the fan is running the damper is open, and when the fan is stopped the damper is closed. Automatic closing of the damper prevents cold air reaching the tempering coils, and possible damage due to freezing when the system is not in operation.

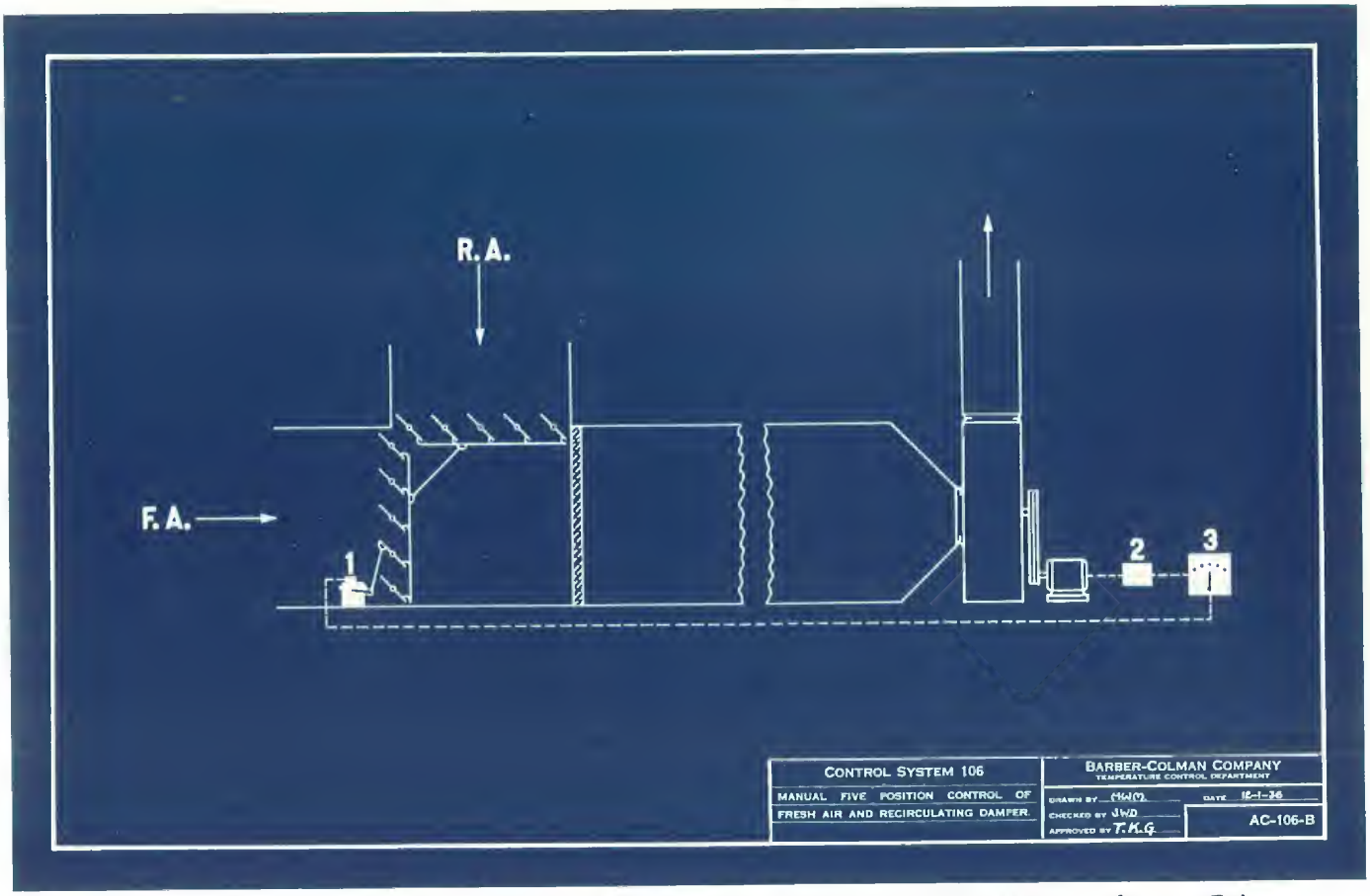
The size of the Fresh Air opening, usually about one-third of the Recirculated Air opening, is determined by the amount of Fresh Air required for ventilation.

Switch (3) is provided so that the Fresh Air Damper may be closed, even though the fan is running, to permit rapid warm-up after a shutdown period, by use of full recirculation.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 106

Five-Position Control of Fresh Air and Recirculating Dampers from Manually Operated Switch.



The above layout illustrates the control of a combination Fresh Air and Recirculating Damper from a 5-Point Switch with automatic closing of Fresh Air Damper when fan stops.

Controls	Data Sheet
1. 5-Position Reversible Damper Control Motor, Group DC-600	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. 5-Point Switch, cYZe 921 or 922	A-10

DESCRIPTION OF OPERATION

Relay (2) controls Reversible Damper Control Motor (1), which in turn operates the combination Fresh Air and Recirculating Damper in such a manner that when the fan is running the Fresh Air Damper is opened to a position determined by the setting of the 5-Point Switch. When the fan is stopped, the Fresh Air Damper is closed. Automatic closing of the Fresh Air Damper prevents cold air reaching the tempering coils, and possible damage due to freezing when the system is not in operation.

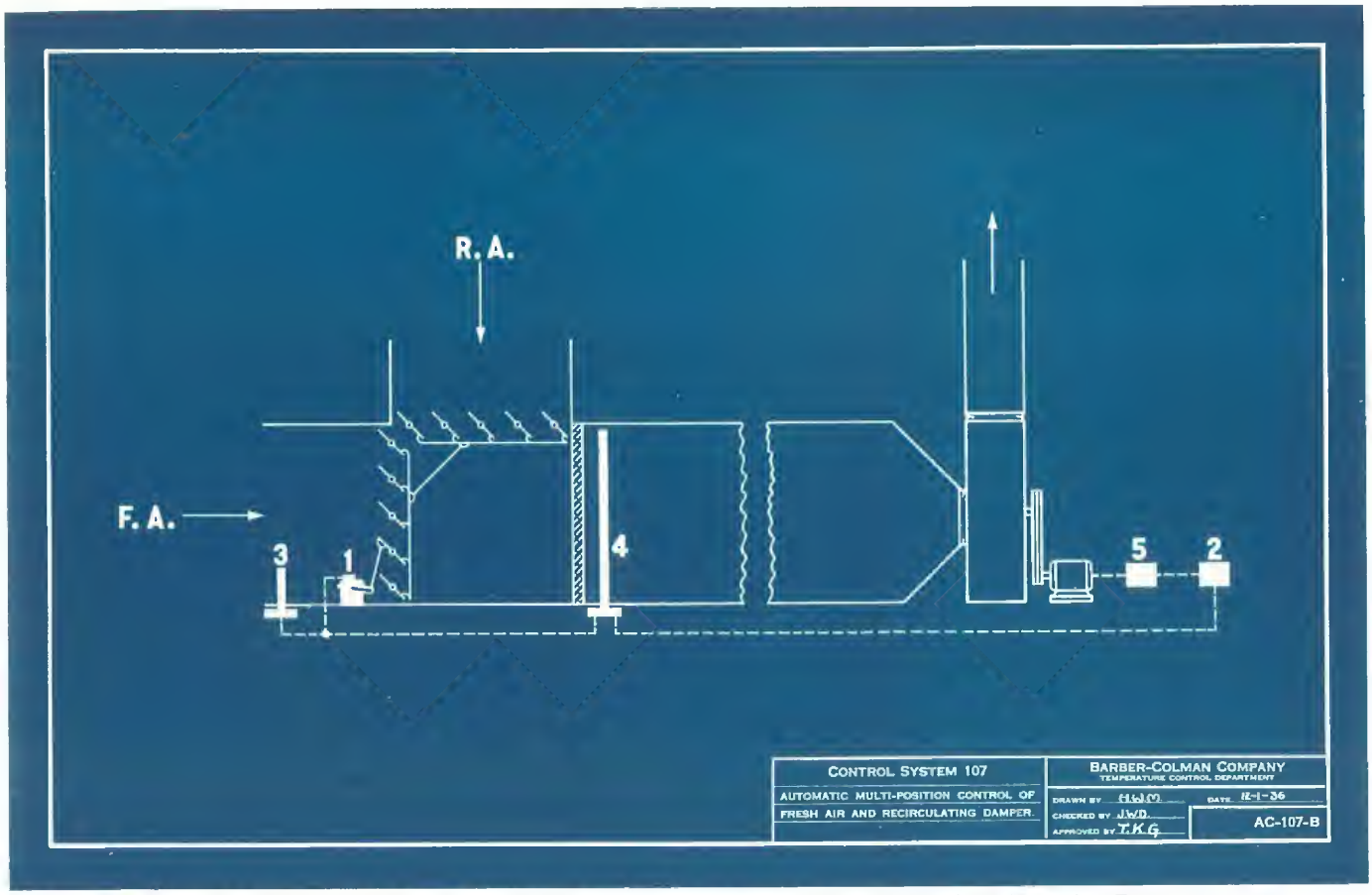
The arrangement of the five positions of the Fresh Air Damper, expressed in per cent of full opening, is usually 0, 25, 50, 75, and 100. Selection of the position of the Fresh Air Damper makes it possible to compensate for seasonal conditions, and also permits rapid warm-up after a shutdown period, by the use of full recirculation.

If multi-position control of the Fresh Air Damper is desired, Microrelay should be added, Microtrol substituted for the 5-Position Damper Control Motor, and a Rheostat used in place of the 5-Point Switch. With this combination, the Fresh Air Damper may be positioned exactly in accordance with the position selected by the Rheostat.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 107

Multi-Position Control of Fresh Air and Recirculating Dampers from Average Temperature of Plenum Chamber.



The above layout illustrates automatic control of a combination Fresh Air and Recirculating Damper.

Controls	Data Sheet
1. 5-Position Reversible Damper Control Motor, Group DC-600	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Insertion Thermostat, fYDj 104	T-10
4. Air Stream Thermostat	T-10
5. Single Pole, Double Throw Switch, sYZe 3 or 4	A-10

DESCRIPTION OF OPERATION

Relay (2) controls Reversible Damper Control Motor (1), which in turn operates the combination Fresh Air and Recirculating Damper in such a manner that when the fan is running, the Fresh Air Damper is opened at least to the minimum position, and when the fan is stopped, the Fresh Air Damper is closed. The minimum position to which the Fresh Air Damper may be opened is usually 25% open, or that point which will admit only sufficient Fresh Air for ventilation. Automatic closing of the Fresh Air Damper prevents cold air reaching the tempering coils, and possible damage due to freezing when the system is not in operation. Switch (5) is provided so that the Fresh Air Damper may be closed, even though the fan is running, to permit rapid warm-up after a shutdown period, by the use of full recirculation.

When the temperature of the outside air is above 65 F, it has little or no cooling value; therefore at 65 F, the setting of Thermostat (3), Damper Control Motor (1) is operated to close the Fresh Air Damper to the minimum position.

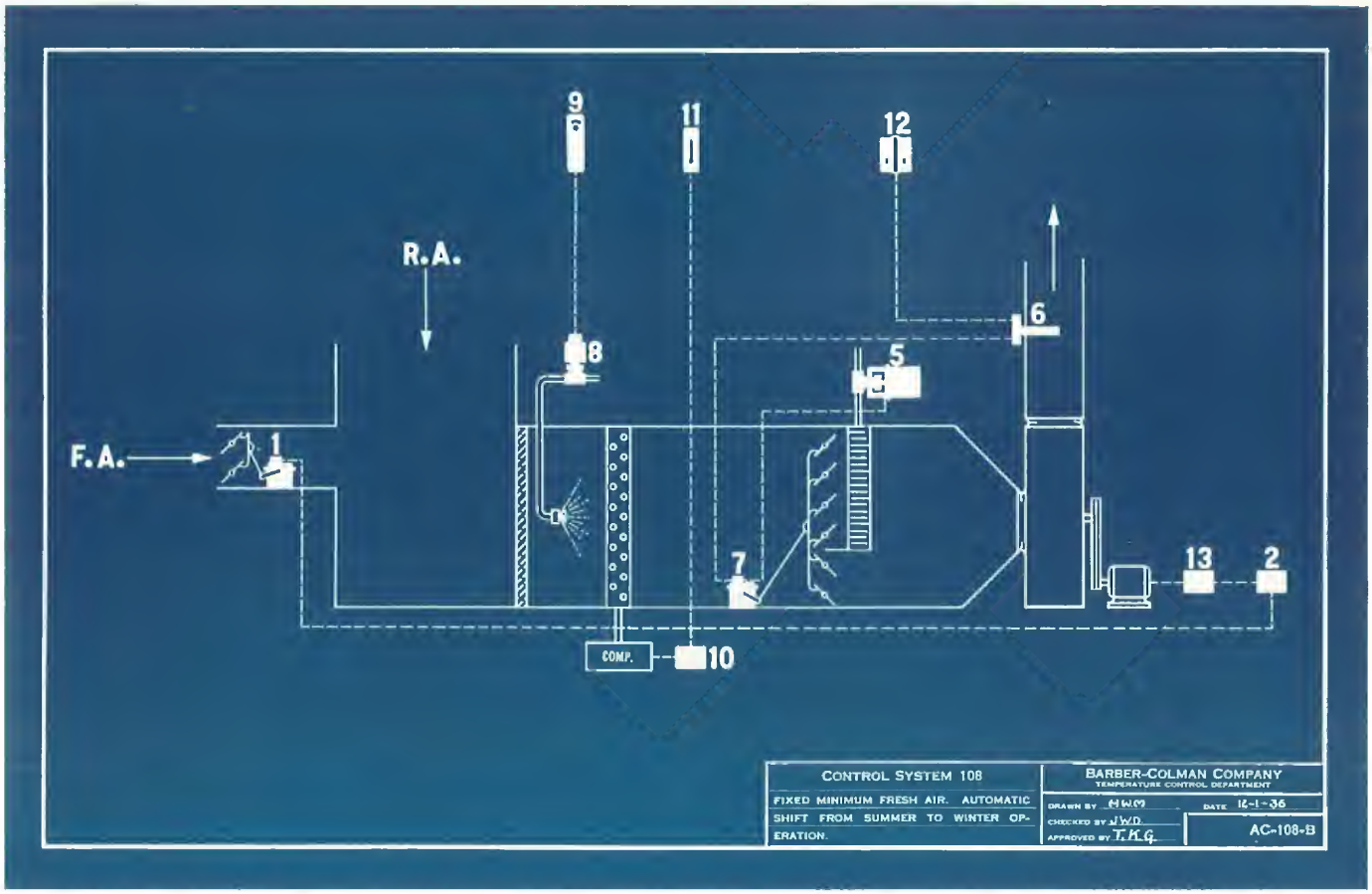
When the temperature of the outside air is below 65 F, control of Damper Control Motor (1) is automatically shifted to Thermostat (4), to automatically proportion the Fresh Air and Recirculated Air. Air Stream Thermostat (4) is set at the lowest temperature desired in the fan discharge, usually about 60 F. It extends across the entire duct and controls from the average temperature in the plenum at this point. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (4).

This arrangement of control is most satisfactory, and increases the economy of the system by eliminating the necessity of running the cooling equipment in mild weather, whenever, and as long as, the outside air has any value as a cooling medium.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 108

Fixed Minimum Fresh Air. Automatic Shift from Summer to Winter Operation.



The above layout represents a simple year-round Air Conditioning System. The controls as shown will give best results. If simplified control of Reheater is desired, see Control Systems 101 and 102. The shift from Summer to Winter operation is made automatically at any time.

Controls	Data Sheet
1. Unidirectional Damper Control Motor, Group DC-200	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
5. Positive Valve	V-20 or V-40
6. Insertion Thermostat, fYDj 104	T-10
7. Microtrol, Cams C or D, Adj. Speed	DC-10
8. Solenoid Water Valve	V-120
9. Hygrostat	H-10
10. Single Pole, Single Throw Relay, cYZp 1-1	A-10
11. Thermostat, YDa 291	T-10
12. Microtherm	T-10
13. Single Pole, Double Throw Switch, sYZe 3 or 4	A-10

DESCRIPTION OF OPERATION

Temperatures selected for illustration can, of course, be varied, but the same relative setting of the Thermostats must be used for proper functioning of the system.

Fresh Air Damper Control. Relay (2) controls Damper Control Motor (1), which in turn operates the Fresh Air Damper in such a manner that when the fan is running the damper is open, and when the fan is stopped the damper is closed. Automatic closing of the damper prevents cold air reaching the tempering coils, and possible damage due to freezing when the system is not in operation. Switch (13) is provided so that the Fresh Air Damper may be closed, even though the fan is running, to permit rapid warm-up after a shut-down period, by the use of full recirculation.

The size of the Fresh Air opening, usually about one-third of the Recirculated Air opening, is determined by the amount of fresh air required for ventilation.

Humidity Control. *Heating Cycle.* Hygrostat (9), set at 30%, controls the operation of Solenoid Valve (8) to add moisture and maintain the desired relative humidity.

CONTROL SYSTEM 108—Continued

Cooling Cycle. If desired, an additional Hygrostat, set at 55%, and wired in parallel with Thermostat (11), may be used to control the compressor to prevent the relative humidity from rising above this point.

Refrigeration Control. For the sake of simplicity, it is assumed that refrigeration is furnished by a compressor and direct expansion coils. (For control of other types of refrigeration, see Part VI.) The cooling equipment is usually manually shut off during Winter operation. However, if a Hygrostat is used to control the compressor to prevent too high relative humidity, the compressor should be kept in automatic operation.

Cooling. Thermostat (11) controls the operation of the compressor through Relay (10) to maintain a room temperature of 75 F. Therefore, whenever the temperature rises above 75 F, the system automatically changes to the cooling cycle.

Reheater Control. *Heating Cycle.* Microtherm (12) set at 70 F, in conjunction with Thermostat (6), operates Microtrol (7) which in turn operates Positive Valve (5) and the Face and By-pass Damper to maintain a constant temperature in the conditioned space. This is accomplished by regulating the amount of air by-passed under the coil and that passed through the coil.

Positive Valve (5) on the steam line is controlled from the auxiliary switches in Microtrol (7) in such a manner that it is open whenever the Face Damper allows air to pass through the coil and is closed whenever the Face Damper is closed.

Upon continued demands for heat, all air is directed through the coil; upon continued demands for cooling all air is directed under the coil through the by-pass. In intermediate positions accurate proportioning is obtained.

The adjustable speed mechanism on Microtrol (7) makes it possible to regulate the dampers on the job, for a speed best suited to each individual installation. For a more simplified control of the Reheater, see Control Systems 101 and 102.

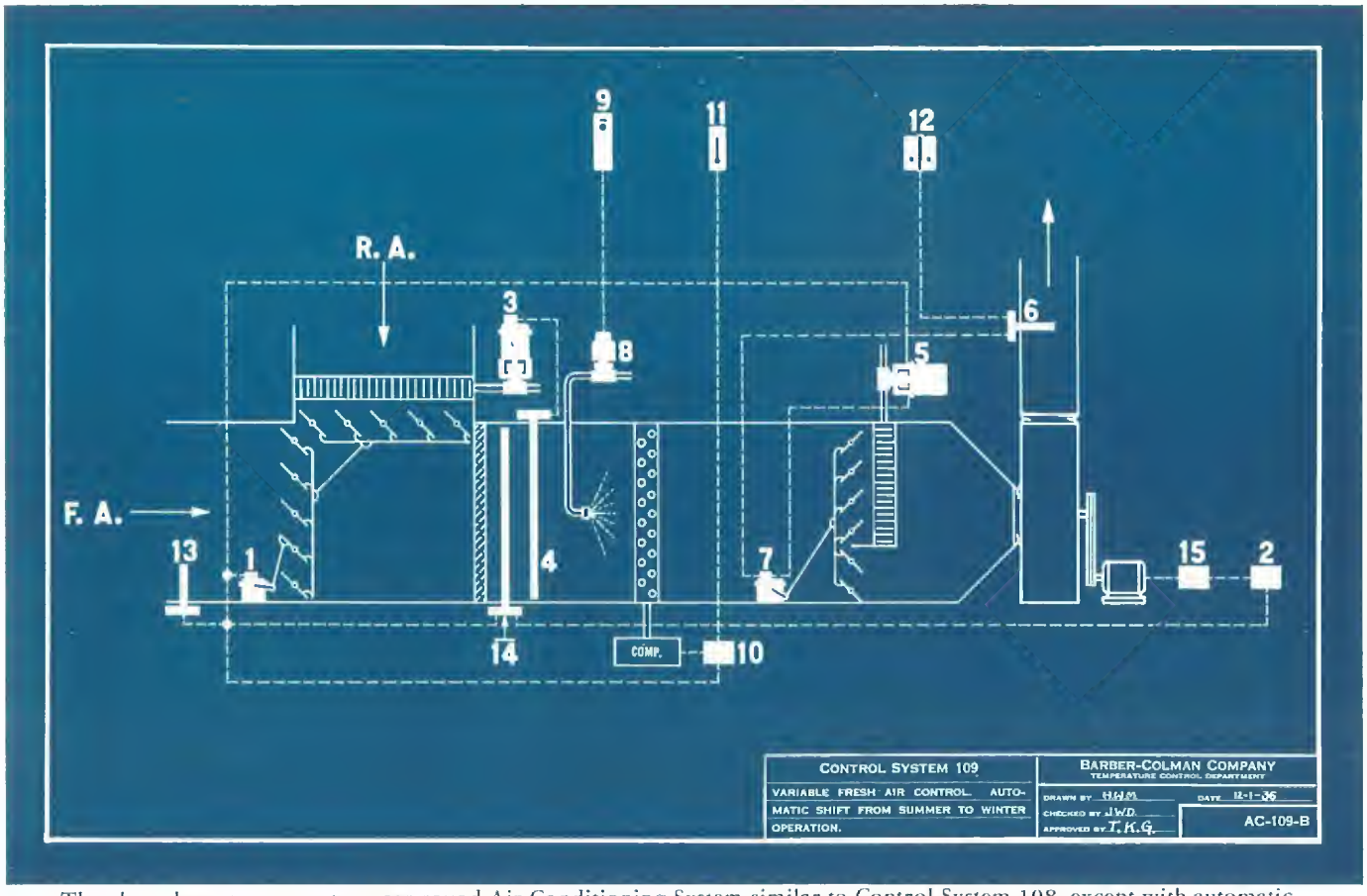
Thermostat (6) operates Microtrol (7) and Positive Valve (5) in the same manner as Microtherm (12) but independently of it. It acts as a low limit to prevent the temperature of the air in the fan discharge ever dropping below 60 F. In this way the possibility of cold drafts is eliminated should there be a prolonged demand for cooling, or a sudden cooling load imposed during the heating season.

Cooling Cycle. If a Hygrostat is used to keep the compressor running whenever necessary to reduce the relative humidity, there is a possibility of producing too low a temperature in the conditioned space. However, if steam is available during Summer operation, reheating will be accomplished the same as during Winter operation, and Low Limit Thermostat (6) will maintain a minimum temperature of 60 F.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 109

Variable Fresh Air Control. Automatic Shift from Summer to Winter Operation.



The above layout represents a year-round Air Conditioning System similar to Control System 108, except with automatic control of Fresh Air and Recirculated Air. If simplified Reheater control is desired, see Control Systems 101 and 102. The shift from Summer to Winter operation is made automatically at any time.

Controls	Data Sheet
1. Reversible Damper Control Motor, Group DC-600	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Throttling Valve	V-80
4. Air Stream Thermostat	T-10
5. Positive Valve	V-20 or V-40
6. Insertion Thermostat, fYDj 104	T-10
7. Microtrol, Cams C or D, Adj. Speed	DC-10
8. Solenoid Water Valve	V-120
9. Hygrostat	H-10
10. Single Pole, Single Throw Relay, cYZp 1-1	A-10
11. Thermostat, YDa 291	T-10
12. Microtherm	T-10
13. Insertion Thermostat, fYDj 104	T-10
14. Air Stream Thermostat	T-10
15. Single Pole, Double Throw Switch, sYZe 3 or 4	A-10

DESCRIPTION OF OPERATION

Temperatures selected for illustration can, of course, be varied, but the same relative setting of the Thermostats must be used for proper functioning of the System.

Fresh Air Damper Control. Relay (2) controls Reversing Damper Control Motor (1) which in turn operates the combination Fresh Air and Recirculating Damper in such a manner that when the fan is running the Fresh Air Damper is opened at least to the minimum position and when the fan is stopped the Fresh Air Damper is closed. The minimum position to which the Fresh Air Damper may be opened is usually 25% open, or that point which will admit only sufficient Fresh Air for ventilation. Automatic closing of the Fresh Air Damper prevents damage due to freezing when the system is not in operation. Switch (15) is provided so that the Fresh Air Damper may be closed, even though the fan is running, to permit rapid warm-up after a shutdown period, by the use of full recirculation.

CONTROL SYSTEM 109—Continued

When the temperature of the outside air is above 65 F it has little or no cooling value; therefore at 65 F, the setting of Thermostat (13), Damper Control Motor (1) is operated to close Fresh Air Damper to the minimum position.

When the temperature of the outside air is below 65 F, control of Damper Control Motor (1) is automatically shifted to Thermostat (14) to automatically proportion the Fresh Air and Recirculated Air. Air Stream Thermostat (14) is set at the lowest temperature desired in the fan discharge, usually about 60 F. It extends across the entire duct and controls from the average temperature in the plenum at this point. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (14).

This arrangement of control is most satisfactory, and increases the economy of the system by eliminating the necessity of running the cooling equipment in mild weather whenever, and as long as, the outside air has any value as a cooling medium.

Additional economy of operation is obtained by the interlocking circuit from Positive Valve (5) to Reversible Damper Control Motor (1). This arrangement causes the Fresh Air Damper to close to the minimum position whenever Valve (5) on Reheater is open, thus preventing the possibility of admitting more than the minimum amount of Fresh Air when reheating is required.

Preheater Control. Air Stream Thermostat (4) set at 57 F operates Throttling Valve (3) to prevent the average temperature of the air entering the plenum dropping below 57 F. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (4). Because of the fact that the Reheater or tempering coil is placed in the Recirculating Air Duct, it is possible to use a Throttling Valve (3) without danger of freezing in the coils.

Humidity Control. *Heating Cycle.* Hygrostat (9), set at 30%, controls the operation of Solenoid Valve (8) to add moisture and maintain the desired relative humidity.

Cooling Cycle. If desired, an additional Hygrostat, set at 55%, and wired in parallel with Thermostat (11), may be used to control the compressor to prevent the humidity rising above this point.

Refrigeration Control. For the sake of simplicity, it is assumed that refrigeration is furnished by a compressor and direct expansion coils. (For control of other types of refrigeration, see Part VI.) The cooling equipment is usually manually shut off during Winter operation. However, if a Hygrostat is used to control the compressor to prevent too high relative humidity, the compressor should be kept in automatic operation.

Cooling. Thermostat (11), set several degrees higher than Microtherm (12), controls the operation of the compressor through Relay (10) to maintain a room temperature of 75 F. Therefore, whenever the temperature rises above 75 F the system automatically changes to the cooling cycle.

By employing the interlocking circuit between Relay (10) and Reversible Damper Control Motor (1) the compressor can be prevented from starting whenever more than the minimum amount of Fresh Air is being admitted. This connection is optional, but can be used to advantage where it is known that 65 F outside air will always give sufficient cooling. If the compressor should be required to operate even though Fresh Air at 65 F or less is being admitted, then this connection should not be used.

Reheater Control. *Heating Cycle.* Microtherm (12), set at 70 F, in conjunction with Low Limit Thermostat (6), operates Microtrol (7), which in turn operates the Face and By-pass Damper and Positive Valve (5) to maintain a constant temperature in the conditioned space. For detailed description of operation of Reheater, see Control System 108.

The interlocking circuit between Positive Valve (5) and Reversible Damper Control Motor (1) is described above in the last paragraph under Fresh Air Damper Control.

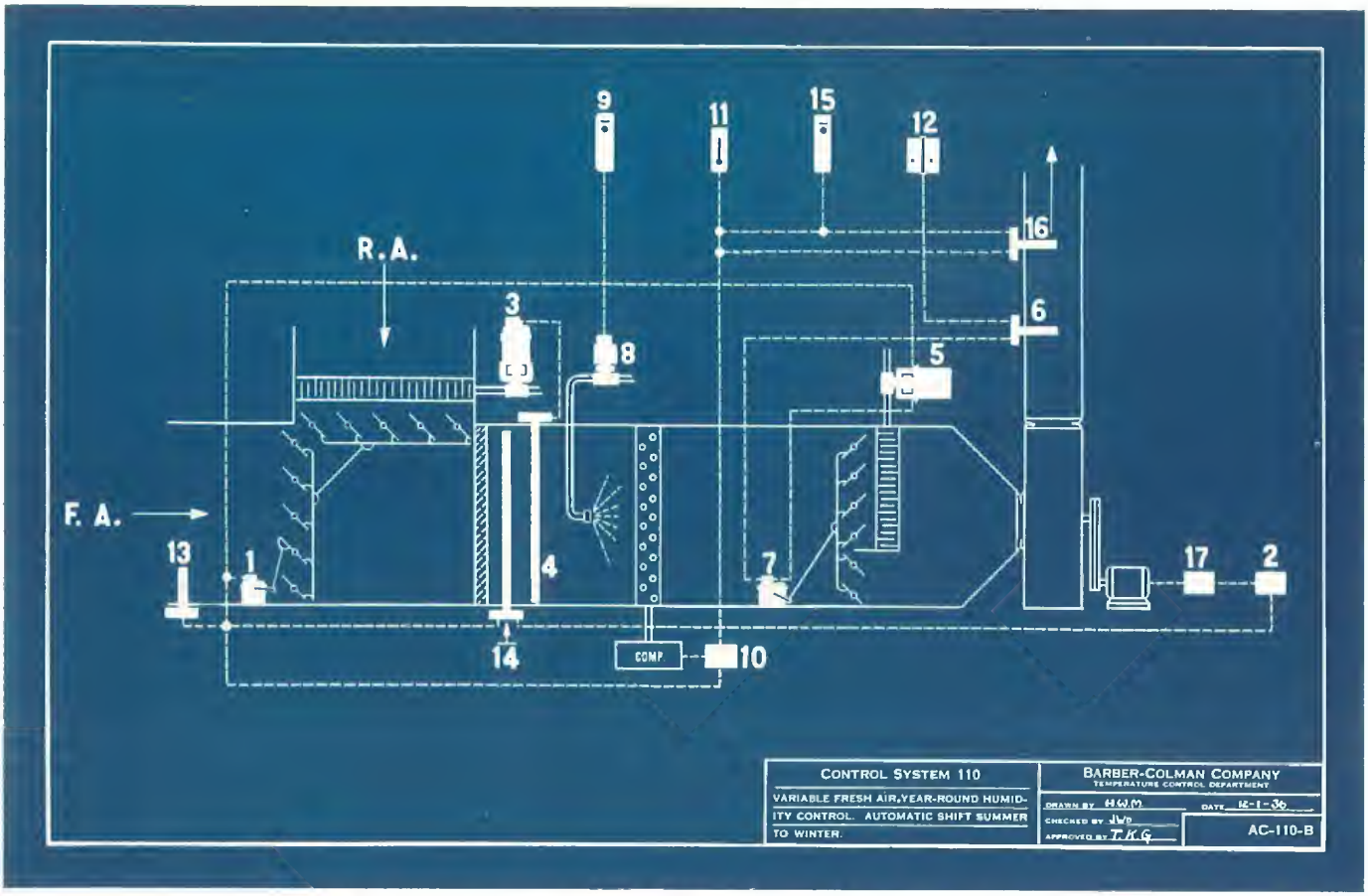
Thermostat (6) operates Microtrol (7) and Positive Valve (5) in the same manner as Microtherm (12) but independently of it. It acts as a low limit to prevent the temperature of the air in the fan discharge ever dropping below 60 F. In this way the possibility of cold drafts is eliminated, should there be a prolonged demand for cooling, or a sudden cooling load imposed during the heating season.

Cooling Cycle. If a Hygrostat is used to keep the compressor running whenever necessary to reduce the relative humidity, there is a possibility of producing too low a temperature in the conditioned space. However, if steam is available during Summer operation, reheating will be accomplished the same as during Winter operation, and Low Limit Thermostat (6) will maintain a minimum temperature of 60 F.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 110

Variable Fresh Air Control. Humidity Control Summer and Winter. Automatic Shift from Summer to Winter Operation.



The above layout represents a year-round Air Conditioning System similar to Control System 109 with the addition of humidity control in Summer. If simplified Reheater control is desired, see Control Systems 101 and 102. The shift from Summer to Winter operation is made automatically at any time.

Controls	Data Sheet
1. Reversible Damper Control Motor, Group DC-600	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Throttling Valve	V-80
4. Air Stream Thermostat	T-10
5. Positive Valve	V-20 or V-40
6. Insertion Thermostat, fYDj 104	T-10
7. Microtrol, Cams C or D, Adj. Speed	DC-10
8. Solenoid Water Valve	V-120
9. Hygrostat	H-10
10. Single Pole, Single Throw Relay, cYZp 1-1	A-10
11. Thermostat, YDa 291	T-10
12. Microtherm	T-10
13. Insertion Thermostat, fYDj 104	T-10
14. Air Stream Thermostat	T-10
15. Hygrostat	H-10
16. Insertion Thermostat, fYDj 104	T-10
17. Single Pole, Double Throw Switch, sYZe 2 or 4	A-10

DESCRIPTION OF OPERATION

Temperatures selected for illustration can, of course, be varied, but the same relative setting of the Thermostats must be used for proper functioning of the system.

Fresh Air Damper Control. Relay (2) controls Reversing Damper Control Motor (1) which in turn operates the combination Fresh Air and Recirculating Damper in such a manner that when the fan is running the Fresh Air Damper is opened at least to the minimum position and when the fan is stopped the Fresh Air Damper is closed. The minimum position to which the Fresh Air Damper may be opened is usually 25% open, or that point which will admit only sufficient Fresh Air for ventilation. Automatic closing of the Fresh Air Damper prevents damage due to freezing when the system is not in operation. Switch (17) is provided so that the Fresh Air Damper may be closed, even though the fan is running, to permit rapid warm-up after a shutdown period, by the use of full recirculation.

CONTROL SYSTEM 110—Continued

When the temperature of the outside air is above 65 F, it has little or no cooling value; therefore at 65 F, the setting of Thermostat (13), Damper Control Motor (1) is operated to close Fresh Air Damper to the minimum position.

When the temperature of the outside air is below 65 F, control of Damper Control Motor (1) is automatically shifted to Thermostat (14) to automatically proportion the Fresh Air and Recirculated Air. Air Stream Thermostat (14) is set at the lowest temperature desired in the fan discharge, usually about 60 F. It extends across the entire duct and controls from the average temperature in the plenum at this point. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (14).

This arrangement of control is most satisfactory, and increases the economy of the system by eliminating the necessity of running the cooling equipment in mild weather whenever, and as long as, the outside air has any value as a cooling medium.

Additional economy of operation is obtained by the interlocking circuit from Positive Valve (5) to Reversible Damper Control Motor (1). This arrangement causes the Fresh Air Damper to close to the minimum position whenever Valve (5) on Reheater is open, thus preventing the possibility of admitting more than the minimum amount of Fresh Air when reheating is required.

Preheater Control. Air Stream Thermostat (4) set at 57 F operates Throttling Valve (3) to prevent the average temperature of the air entering the plenum dropping below 57 F. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (4). Because of the fact that the Reheater or tempering coil is placed in the Recirculated Air duct it is possible to use a Throttling Valve (3) without danger of freezing in the coils.

Humidity Control. *Heating Cycle.* Hygrostat (9), set at 30%, controls the operation of Solenoid Valve (8) to add moisture and maintain the desired relative humidity.

Cooling Cycle. Hygrostat (15) set at 55%, controls the operation of Relay (10) and will start the compressor at any time the humidity rises above this setting and keep it running until the humidity is decreased. Note: Thermostat (11) also controls the operation of the compressor (to take care of the cooling requirements) but Hygrostat (15) has preference over Thermostat (11) whenever it is necessary to reduce the humidity. During the time that Hygrostat (15) is keeping the compressor running, the temperature of the air in the fan discharge may drop below 63 F, the setting of Thermostat (16), but when the temperature reaches 60 F, the setting of Thermostat (6), then reheating takes place to maintain a minimum of 60 F air in the fan discharge, thus preventing cold drafts.

Refrigeration Control. For the sake of simplicity it is assumed that refrigeration is furnished by a compressor and direct expansion coils. (For control of other types of refrigeration, see Part VI.)

Cooling. Thermostat (11), set several degrees higher than Microtherm (12), controls the operation of the compressor through Relay (10) to maintain a room temperature of 75 F. Therefore, whenever the temperature rises above 75 F, the system automatically changes to the cooling cycle. Low Limit Thermostat (16), set at 63 F or a few degrees higher than the setting of Thermostat (6), cuts off the compressor to prevent possibility of cold drafts. As long as the compressor is controlled by Room Thermostat (11) the temperature in the fan discharge will never go below 63 F, the setting of Low Limit Thermostat (16), and will, therefore, never require reheating, because when Low Limit Thermostat (16) cuts off the compressor all further cooling is stopped.

Dehumidifying. In order to reduce the humidity, Hygrostat (15) may operate Relay (10) and keep the compressor running even though Thermostats (11) and (16) are satisfied. Cold drafts are eliminated by reheating to prevent the temperature of the air dropping below 60 F, the setting of Thermostat (6).

Reheater Control. *Heating Cycle.* Microtherm (12) set at 70 F, in conjunction with Low Limit Thermostat (6), operates Microtrol (7), which in turn operates the Face and By-pass Damper and Positive Valve (5) to maintain a constant temperature in the conditioned space. For detailed description of operation see Control System 108.

The interlocking circuit between Positive Valve (5) and Reversible Damper Control Motor (1) is described above in the last paragraph under Fresh Air Damper Control.

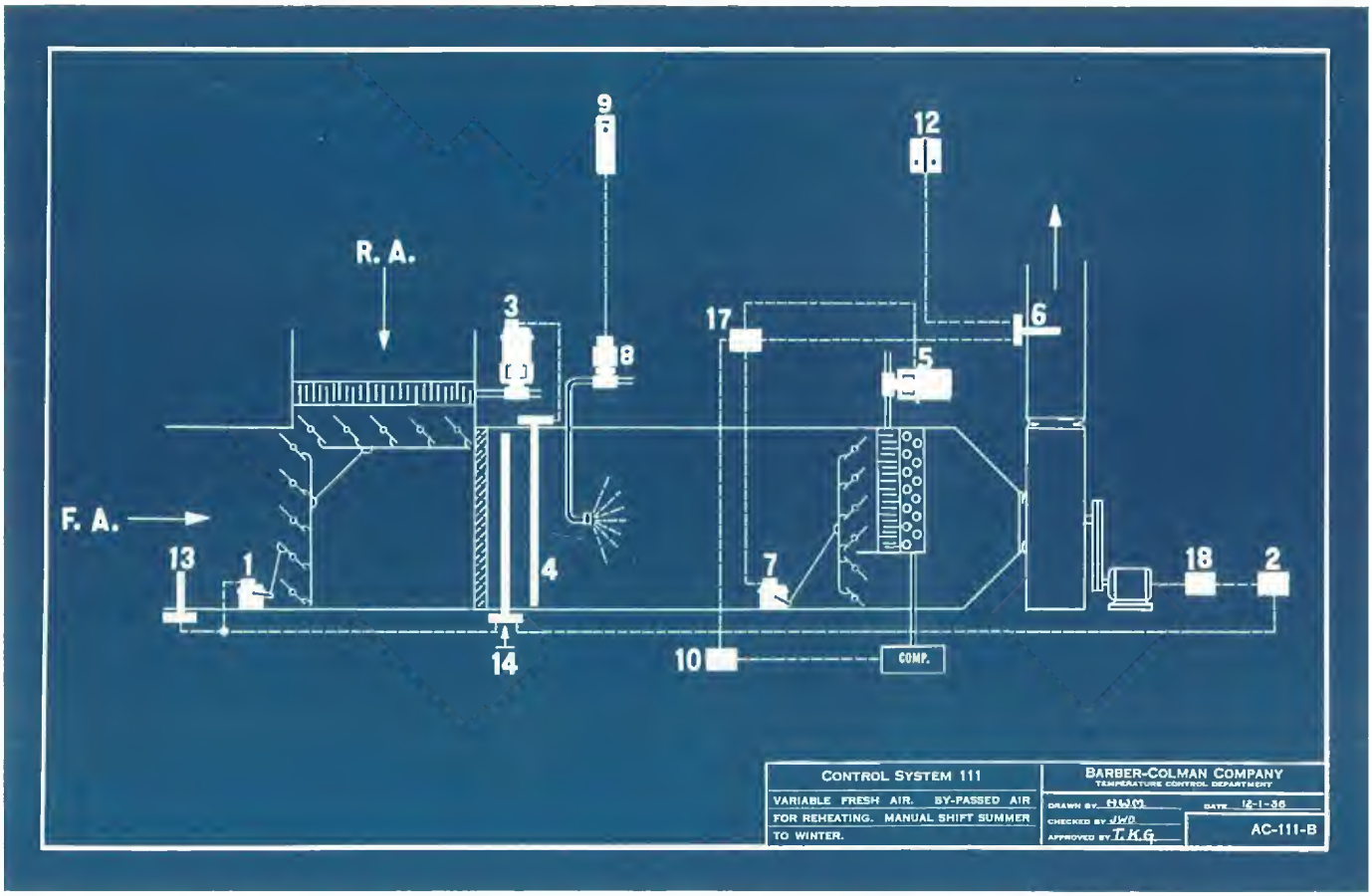
Thermostat (6) operates Microtrol (7) and Positive Valve (5) in the same manner as Microtherm (12), but independently of it. It acts as a low limit to prevent the temperature of the air in the fan discharge ever dropping below 60 F. In this way the possibility of cold drafts is eliminated should there be a prolonged demand for cooling, or a sudden cooling load imposed during the heating season or during the cooling season when reheating may be required because of continued operation of the compressor to reduce the relative humidity.

Cooling Cycle. If a Hygrostat is used to keep the compressor running whenever necessary to reduce the humidity, there is a possibility of producing too low a temperature in the conditioned space. However, if steam is available during Summer operation, reheating will be accomplished the same as during the Winter operation and Low Limit Thermostat (6) will maintain a minimum temperature of 60 F.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 111

Variable Fresh Air Control. By-passed Air Used for Reheating. Manual Shift from Summer to Winter Operation.



The above layout represents a year-round Air Conditioning System similar to Control System 110, except for the arrangement of the Cooling Coil which permits by-passing air for reheating in Summer. Humidity is controlled in Winter only. Shift from Summer to Winter operation is made by a manually operated switch which reverses the operation of the Face and By-pass Damper.

Controls	Data Sheet
1. Reversible Damper Control Motor, Group DC-600	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Throttling Valve	V-80
4. Air Stream Thermostat	T-10
5. Positive Valve	V-20 or V-40
6. Insertion Thermostat, fYDj 104	T-10
7. Microtrol, Cams C or D, Adj. Speed	DC-10
8. Solenoid Water Valve	V-120
9. Hygrostat	H-10
10. Single Pole, Single Throw Relay, cYZp 1-1	A-10
12. Microtherm	T-10
13. Insertion Thermostat, fYDj 104	T-10
14. Air Stream Thermostat	T-10
17. 4-Pole, Double Throw Switch	A-10
18. Single Pole, Double Throw Switch, sYZe 3 or 4	A-10

DESCRIPTION OF OPERATION

Temperatures selected for illustration can, of course, be varied, but the same relative setting of the Thermostats must be used for proper functioning of the system.

Fresh Air Damper Control. Relay (2) controls Reversing Damper Control Motor (1) which in turn operates the combination Fresh Air and Recirculating Damper in such a manner that when the fan is running the Fresh Air Damper is opened at least to the minimum position and when the fan is stopped the Fresh Air Damper is closed. The minimum position to which the Fresh Air Damper may be opened is usually 25% open, or that point which will admit only sufficient Fresh Air for ventilation. Automatic closing of the Fresh Air Damper prevents damage due to freezing when the system is not in operation. Switch (18) is provided so that the Fresh Air Damper may be closed, even though the fan is running, to permit rapid warm-up after a shutdown period, by the use of full recirculation.

When the temperature of the outside air is above 65 F, it has little or no cooling value; therefore at 65 F, the setting of Thermostat (13), Damper Control

CONTROL SYSTEM 111—Continued

Motor (1) is operated to close Fresh Air Damper to the minimum position.

When the temperature of the outside air is below 65 F, control of Damper Control Motor (1) is automatically shifted to Thermostat (14) to automatically proportion the Fresh Air and Recirculated air. Air Stream Thermostat (14) is set at the lowest temperature desired in the fan discharge, usually about 60 F. It extends across the entire duct and controls from the average temperature in the plenum at this point. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (14).

This arrangement of control is most satisfactory, and increases the economy of the system by eliminating the necessity of running the cooling equipment in mild weather whenever, and as long as, the outside air has any value as a cooling medium.

Preheater Control. Air Stream Thermostat (4) set at 57 F operates Throttling Valve (3) to prevent the average temperature of the air entering the plenum dropping below 57 F. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (4). Because of the fact that the Reheater or tempering coil is placed in the Recirculated Air duct, it is possible to use a Throttling Valve (3) without danger of freezing in the coils.

Humidity Control. *Heating Cycle.* Hygrostat (9) set at 30% controls the operation of Solenoid Valve (8) to add moisture and maintain the desired relative humidity.

Cooling Cycle. Due to the arrangement of the cooling coil and the fact that by-passed air is used for reheating, it is usually considered unnecessary to provide any humidity control during the cooling cycle.

Refrigeration Control. For the sake of simplicity it is assumed that refrigeration is furnished by a compressor and direct expansion coils. (For control of other types of refrigeration, see Part VI.) When Switch (17) is in the Winter position, the cooling equipment is cut out and cannot operate.

Cooling and Dehumidifying. When Switch (17) is in the Summer position, Positive Valve (5) is run to the closed position and remains closed during the entire cooling cycle. Microtherm (12) operates Microtrol (7) which in turn operates the Face and By-pass Damper to maintain a constant temperature in the space. This is accomplished by regulating the amount of air by-passed under the coil and that passed through the coil. Upon continued demands for cooling, all air is directed through the coil. Upon continued demands for heating, all air is directed under the coil through the by-pass. In intermediate positions accurate proportioning is obtained. Relay (10) which operates the compressor, is controlled from the auxiliary switches in Microtrol (7) in such a manner that the compressor runs whenever, and as long as, Face Damper is open to allow any air to pass through the cooling coil.

Thermostat (6) operates Microtrol (7) in the same manner as Microtherm (12) but independently of it. It acts as a low limit to prevent the temperature of the air in the fan discharge ever dropping below 60 F. In this way the possibility of cold drafts is eliminated should there be a prolonged demand for cooling.

Reheater Control. When Switch (17) is in the Summer position, Valve (5) is run to the closed position, and remains closed regardless of the position of the Face and By-pass Damper.

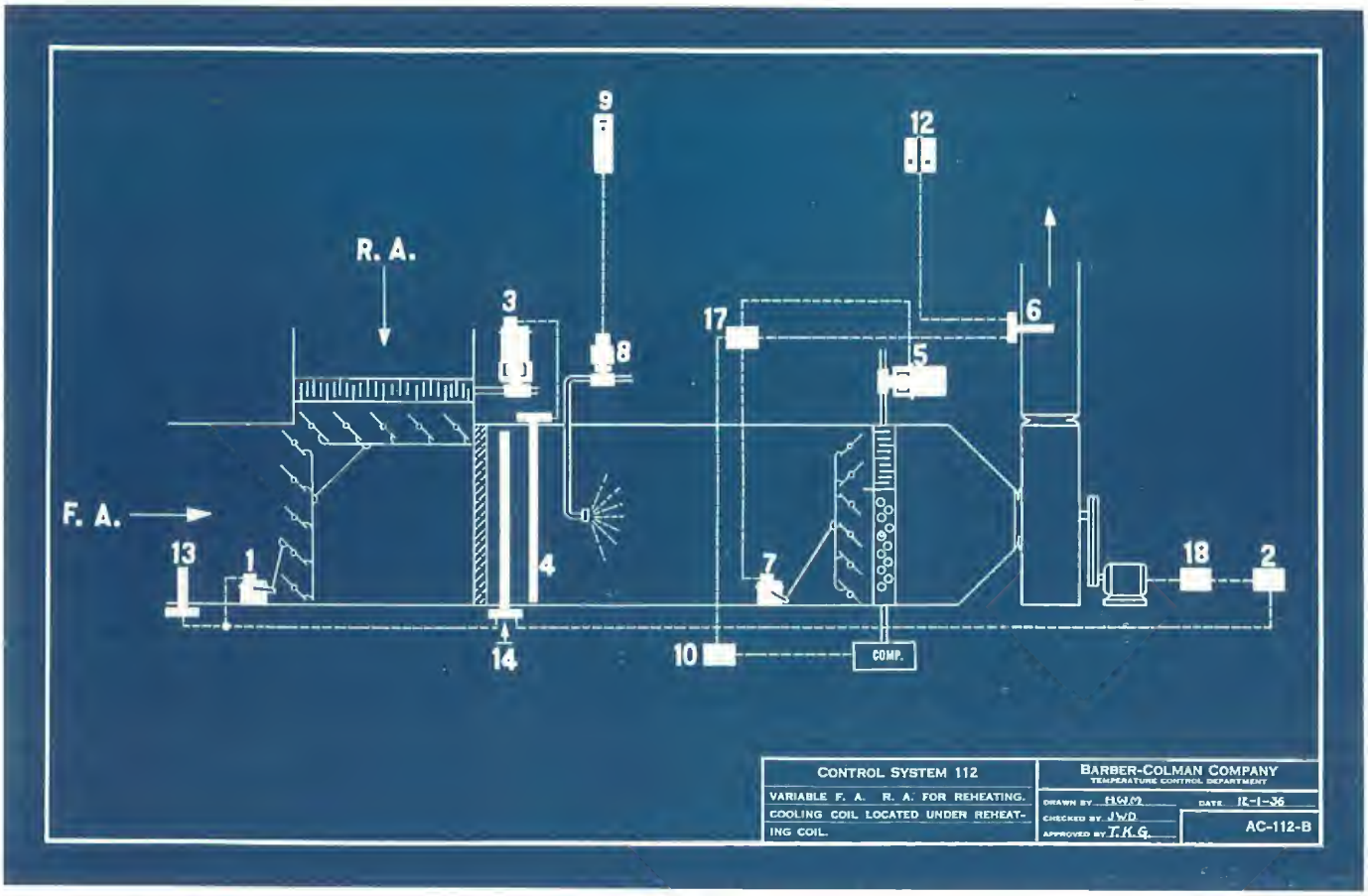
Heating Cycle. When Switch (17) is in the Winter position, the cooling equipment is cut out and cannot operate. Operation of Microtrol (7) and the Face and By-pass Damper is the reverse of that described above under cooling and dehumidifying. Upon continued demands for heating all air is directed through the coil; upon continued demands for cooling all air is directed through the by-pass. In intermediate positions, accurate proportioning is obtained. Positive Valve (5) is operated from the auxiliary switches in Microtrol (7). For detailed description of operation of Reheater, see Control System 108.

Thermostat (6) operates Microtrol (7) and Positive Valve (5) in the same manner as Microtherm (12) but independently of it. It acts as a low limit to prevent the temperature of the air in the fan discharge ever dropping below 60 F. In this way the possibility of cold drafts is eliminated, should there be a prolonged demand for cooling, or a sudden cooling load imposed during the heating season.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 112

Variable Fresh Air Control. By-passed Air used for Reheating. Cooling Coil Located under Reheating Coil. Manual Shift from Summer to Winter Operation.



The above layout represents a year-round Air Conditioning System similar to Control System 111, except for the arrangement of the Reheating and Cooling Coils, which does not necessitate reversing the operation of Face and By-pass Damper. Humidity is controlled in Winter only. Shift from Summer to Winter operation is made by a manually operated switch which closes Valve (5) in Summer, and cuts out the Compressor in Winter.

Controls	Data Sheet
1. Reversible Damper Control Motor, Group DC-600	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Throttling Valve	V-80
4. Air Stream Thermostat	T-10
5. Positive Valve	V-20 or V-40
6. Insertion Thermostat, fYDj 104	T-10
7. Microtrol, Cams C or D, Adj. Speed	DC-10
8. Solenoid Water Valve	V-120
9. Hygrostat	H-10
10. Single Pole, Single Throw Relay, cYZp 1-1	A-10
12. Microtherm	T-10
13. Insertion Thermostat, fYDj 104	T-10
14. Air Stream Thermostat	T-10
17. Double Pole, Double Throw Switch, sYZe 5 or 6	A-10
18. Single Pole, Double Throw Switch, sYZe 3 or 4	A-10

DESCRIPTION OF OPERATION

Temperatures selected for illustration can, of course, be varied, but the same relative setting of the Thermostats must be used for proper functioning of the system.

Fresh Air Damper Control. Relay (2) controls Reversing Damper Control Motor (1) which in turn operates the combination Fresh Air and Recirculating Damper in such a manner that when the fan is running the Fresh Air Damper is opened at least to the minimum position and when the fan is stopped the Fresh Air Damper is closed. The minimum position to which the Fresh Air Damper may be opened is usually 25% open, or that point which will admit only sufficient Fresh Air for ventilation. Automatic closing of the Fresh Air Damper prevents damage due to freezing when the system is not in operation. Switch (18) is provided so that the Fresh Air Damper may be closed, even though the fan is running, to permit rapid warm-up after a shutdown period, by the use of full recirculation.

When the temperature of the outside air is above 65 F, it has little or no cooling value; therefore, at 65 F, the setting of Thermostat (13), Damper Control

CONTROL SYSTEM 112—Continued

Motor (1) is operated to close Fresh Air Damper to the minimum position.

When the temperature of the outside air is below 65 F, control of Damper Control Motor (1) is automatically shifted to Thermostat (14) to automatically proportion the Fresh Air and Recirculated Air. Air Stream Thermostat (14) is set at the lowest temperature desired in the fan discharge, usually about 60 F. It extends across the entire duct and controls from the average temperature in the plenum at this point. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (14).

This arrangement of control is most satisfactory, and increases the economy of the system by eliminating the necessity of running the cooling equipment in mild weather whenever, and as long as, the outside air has any value as a cooling medium.

Preheater Control. Air Stream Thermostat (4) set at 57 F operates Throttling Valve (3) to prevent the average temperature of the air entering the plenum dropping below 57 F. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (4). Because of the fact that the Reheater or tempering coil is placed in the Recirculated Air duct it is possible to use a Throttling Valve (3) without danger of freezing in the coils.

Humidity Control. *Heating Cycle.* Hygrostat (9) set at 30%, controls the operation of Solenoid Valve (8) to add moisture and maintain the desired humidity.

Cooling Cycle. Due to the arrangement of the heating and cooling coils, and the fact that air is by-passed through the heating coil for reheating (even though there is no steam in the coil it serves as a by-pass) it is usually considered unnecessary to provide any humidity control during the cooling cycle.

Refrigeration Control. For the sake of simplicity it is assumed that refrigeration is furnished by a compressor and direct expansion coils. (For control of other types of refrigeration see Part VI). When Switch (17) is in the Winter position the cooling equipment is cut out and cannot operate.

Cooling and Dehumidifying. When Switch (17) is in the Summer position, Positive Valve (5) is run to the closed position and remains closed during the entire cooling period. Microtherm (12) operates Microtrol (7), which in turn operates the combination damper to maintain a constant temperature in the space. This is accomplished by regulating the amount of air passed through the cooling coil and that by-passed through the heating coil. Upon continued demands for cooling, all air is directed through the cooling coil; upon continued demands for heating, all air is by-passed. In intermediate positions accurate proportioning is obtained. Relay (10) which operates the compressor, is controlled from the auxiliary switches in Microtrol (7) in such a manner that the compressor runs whenever, and as long as, the damper is open to allow any air to pass through the cooling coil.

Thermostat (6) operates Microtrol (7) in the same manner as Microtherm (12) but independently of it. It acts as a low limit to prevent the temperature of the air in the fan discharge ever dropping below 60 F. In this way the possibility of cold drafts is eliminated, should there be a prolonged demand for cooling.

If manual operation of the compressor is permitted, and no Valve on Reheater coil is required, then Positive Valve (5), Relay (10) and D.P.D.T. Switch (17) may be omitted.

Reheater Control. When Switch (17) is in the Summer position Positive Valve (5) is run to the closed position and remains closed, regardless of the position of the combination damper.

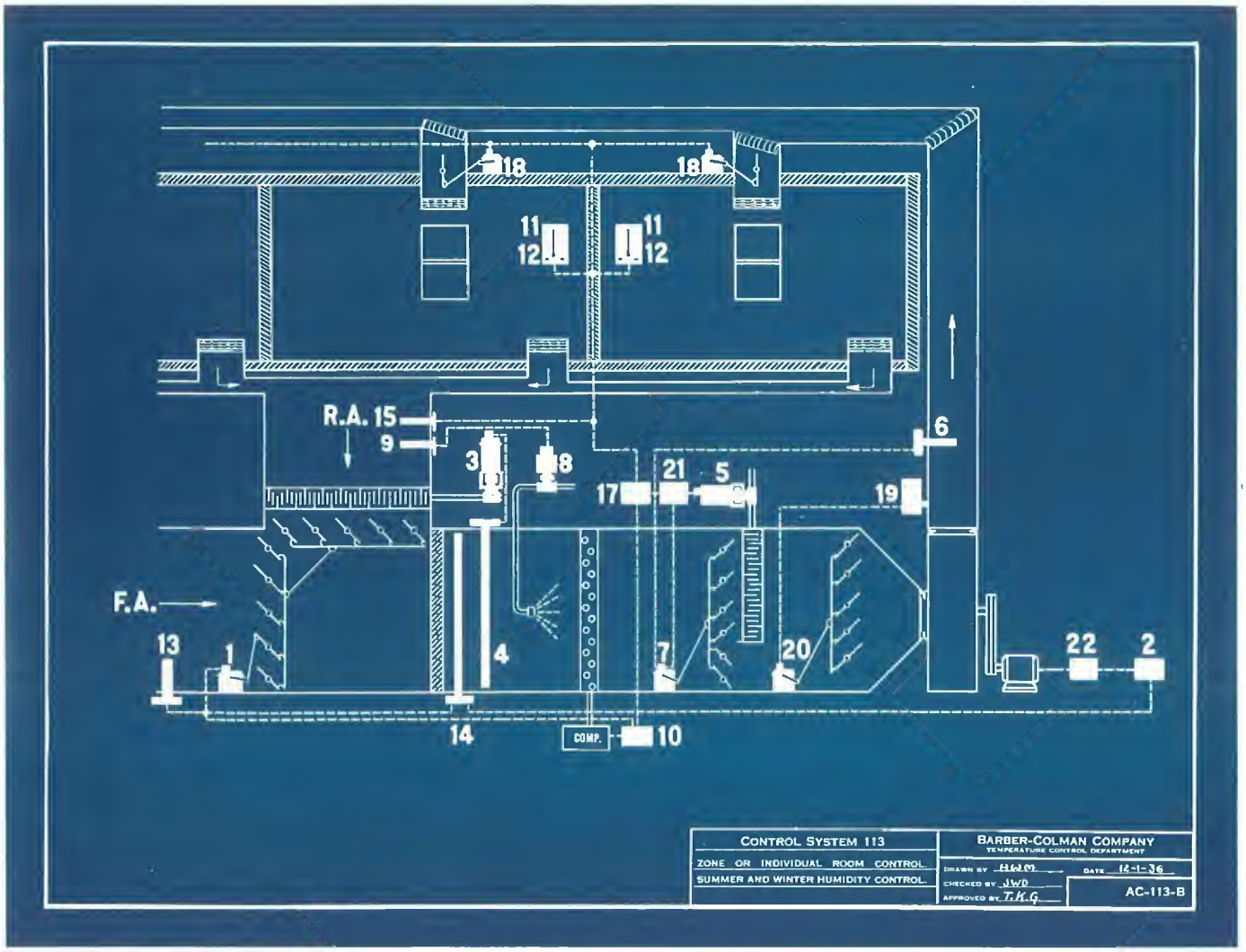
Heating Cycle. When Switch (17) is in the Winter position, the cooling equipment is cut out and cannot operate. Operation of Microtrol (7) and the combination damper is the same as described above under cooling and dehumidifying, except the cooling coil is used as the by-pass for the heating coil. Upon continued demands for heating, all air is directed through the heating coil; upon continued demands for cooling, all air is by-passed. In intermediate positions accurate proportioning is obtained. Positive Valve (5) is controlled from the auxiliary switches in Microtrol (7). For detailed description of operation of Reheater see Control System 108.

Thermostat (6) operates Microtrol (7) and Positive Valve (5) in the same manner as Microtherm (12) but independently of it. It acts as a low limit to prevent the temperature of the air in the fan discharge ever dropping below 60 F. In this way the possibility of cold drafts is eliminated, should there be a prolonged demand for cooling, or a sudden cooling load imposed during the heating season.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 113

Zone or Individual Room Control. Summer and Winter Humidity Control.



The above layout represents a year-round Air Conditioning System similar to Control Systems 109 and 110, but with the addition of individual zone or room control and a Static Pressure Regulator.

Controls	Data Sheet
1. Reversible Damper Control Motor, Group DC-600	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Throttling Valve	V-80
4. Air Stream Thermostat	T-10
5. Throttling Valve	V-20, V-40, or V-80
6. Insertion Thermostat, fYDj 104	T-10
7. Reversible Damper Control Motor, Group DC-500, Cams A, Adj. Speed	DC-10
8. Solenoid Water Valve	V-120
9. Hygrostat, Insertion Type	H-10
10. Single Pole, Single Throw Relay, cYZp 1-1	A-10

Controls	Data Sheet
11 and **12.** Combined as Two-Temperature, Summer-Winter Thermostat, one required for each room or zone	T-10
13. Insertion Thermostat, fYDj 104	T-10
14. Air Stream Thermostat	T-10
15. Hygrostat, Insertion Type	H-10
17. Double Pole, Double Throw Switch—Special	A-10
18. Positive Damper Control Motor, Group DC-200 or 300, one required for each room or zone	DC-10
19. Static Pressure Regulator	
20. Reversible Damper Control Motor, Group DC-500, Adj. Speed	DC-10
21. Single Pole, Double Throw Relay, cYZp 3-1	A-10
22. Single Pole, Double Throw Switch, sYZe 3 or 4	A-10

CONTROL SYSTEM 113—Continued

DESCRIPTION OF OPERATION

Temperatures selected for illustration can, of course, be varied, but the same relative setting of the Thermostats must be used for proper functioning of the system.

Fresh Air Damper Control. Relay (2) controls Reversing Damper Control Motor (1), which in turn operates the combination Fresh Air and Recirculating Damper in such a manner that when the fan is running the Fresh Air Damper is opened at least to the minimum position and when the fan is stopped the Fresh Air Damper is closed. The minimum position to which the Fresh Air Damper may be opened is usually 25% open, or that point which will admit only sufficient Fresh Air for ventilation. Automatic closing of the Fresh Air Damper prevents possible damage due to freezing when the system is not in operation. Switch (22) is provided so that the Fresh Air Damper may be closed, even though the fan is running, to permit rapid warm-up after a shutdown period, by the use of full recirculation.

When the temperature of the outside air is above 65 F, it has little or no cooling value; therefore, at 65 F, the setting of Thermostat (13), Damper Control Motor (1) is operated to close Fresh Air Damper to the minimum position.

When the temperature of the outside air is below 65 F, control of Damper Control Motor (1) is automatically shifted to Thermostat (14) to automatically proportion the Fresh Air and Recirculated Air. Air Stream Thermostat (14) is set at the lowest temperature desired in the fan discharge, usually about 60 F. It extends across the entire duct and controls from the average temperature in the plenum at this point. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (14).

This arrangement of control is most satisfactory, and increases the economy of the system by eliminating the necessity of running the cooling equipment in mild weather whenever, and as long as, the outside air has any value as a cooling medium.

Preheater Control. Air Stream Thermostat (4) set at 57 F operates Throttling Valve (3) to prevent the average temperature of the air entering the plenum dropping below 57 F. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (4). Because of the fact that the Reheater or tempering coil is placed in the Recirculated Air duct it is possible to use a Throttling Valve (3) without danger of freezing in the coils.

Humidity Control. *Heating Cycle.* Hygrostat (9) set at 30%, controls the operation of Solenoid Valve (8) to add moisture and maintain the desired humidity.

Cooling Cycle. Hygrostat (15) set at 55%, controls the operation of Relay (10) and will start the compressor at any time the humidity rises above this setting and keep it running until the humidity is decreased.

Note:—Damper Control Motors (18) also control the operation of the compressor (to take care of the cooling requirements) but Hygrostat (15) has controlling preference whenever it is necessary to reduce the humidity.

Refrigeration Control. For the sake of simplicity it is assumed that refrigeration is furnished by a compressor and direct expansion coils. (For control of other types of refrigeration, see Part VI.) When Switch (17) is in the Winter position, the cooling equipment is cut out and cannot operate.

Cooling and Dehumidifying. When Switch (17) is in the Summer position, Throttling Valve (5) is run to the closed position and remains closed during the entire cooling period. The Compressor is controlled through Relay (10) by any one of Positive Damper Control Motors (18) as described under zone or room control.

By employing an interlocking circuit between Relay (10) and Reversible Damper Control Motor (1) the compressor can be prevented from starting whenever more than the minimum amount of Fresh Air is being admitted. This connection is optional but can be used to advantage where it is known that 65 F outside air will always give sufficient cooling. If the compressor should be required to operate even though Fresh Air at 65 F (or below) is being admitted, this connection should not be used.

In order to reduce the humidity, Hygrostat (15) may operate Relay (10) and keep the compressor running even though all Damper Control Motors (18) are in the closed position. When all of the room dampers are closed the fan is delivering only approximately one-third of its capacity due to the action of the Static Pressure Regulator. Therefore, due to the lower velocity, the air is in contact with the cooling coils for a greater length of time, which provides more effective dehumidification. The result of discharging this small volume of dehumidified air into the rooms, is to lower the humidity without lowering the dry bulb temperature appreciably.

Reheater Control. When Switch (17) is in the Summer position, Throttling Valve (5) is run to the closed position and remains closed, regardless of the position of the Face and By-pass Dampers.

Heating Cycle. When Switch (17) is in the Winter position, the cooling equipment is cut out and cannot operate. Thermostat (6) operates Reversible Damper Control Motor (7), which in turn operates the Face and By-pass Damper to maintain the proper temperature of the air leaving the system. This is accomplished by regulating the amount of air bypassed under the coil and that passed through the coil. Upon continued demands for heating all air is directed

CONTROL SYSTEM 113—Continued

through the coil; upon continued demands for cooling all air is directed under the coil through the by-pass. In intermediate positions accurate proportioning is obtained.

Throttling Valve (5) on the steam line is controlled from the auxiliary switches in Damper Control Motor (7) as described in Control System 104 under Reheater control, with the following exception: when all room dampers are in the closed position, Relay (21) will cause Valve (5) to run to the closed position and remain closed until any one room damper opens. In this way the steam supply to the Reheater coil is cut off, regardless of the demands of Thermostat (6), and without waiting for Damper Control Motor (7) to place the Face and By-pass Damper in the full cooling position (Face closed, By-pass open). Due to there being no steam in the Reheater coil, Thermostat (6) will call for heat, causing Damper Control Motor (7) to place Face and By-pass Damper in the full heating position (Face open, By-pass closed). When any one room damper opens, Relay (21) returns the control of Valve (5) to Thermostat (6) and because the Face and By-pass Damper is in the full heating position, Valve (5) starts to open at once. Control of Valve (5) in this manner gives very rapid response.

The adjustable speed mechanism on both Damper Control Motor (7) and Throttling Valve (5) makes it possible to regulate the dampers and Valve, on the job, for a speed best suited to each individual installation.

Static Pressure Control. Static Pressure Regulator (19) controls Reversing Damper Control Motor (20) which in turn operates the damper to regulate the amount of air entering the fan. In this way any desired constant pressure is maintained in the discharge duct at all times, regardless of the number of zone or room dampers that are open.

Zone or Room Control. *Cooling Cycle.* Each Thermostat (11) controls its respective Positive Damper Control Motor (18) which in turn operates the shut-off damper to the zone or room. These dampers operate so that they are always in either the full open or closed position. In the closed position the dampers will still admit air equal to about one-third of that admitted in the full open position, or that amount required for ventilation. On call for cooling, dampers open; on call for heat, dampers close.

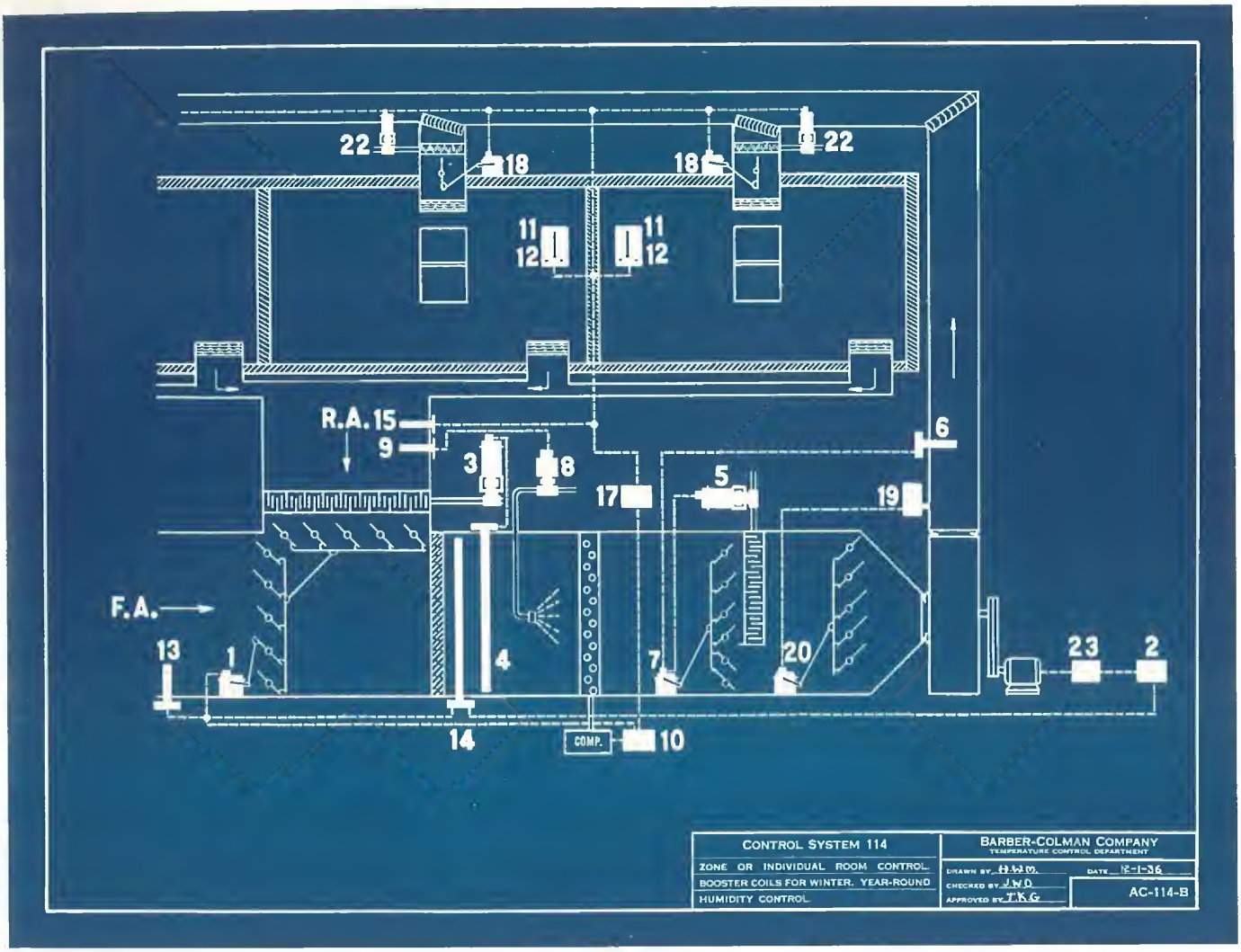
When all dampers are closed, compressor will stop; any one damper opening will cause compressor to start and continue running as long as one or more dampers are open.

Heating Cycle. Each Thermostat (12) controls its respective Positive Damper Control Motor (18) in the same manner as Thermostats (11) only in the reverse order; i.e., on call for heat, dampers open; on call for cooling, dampers close.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 114

Zone or Individual Room Control. Booster Coils for Winter Heating. Summer and Winter Humidity Control.



The above layout represents a year-round Air Conditioning System similar to Control System 113, but with the addition of Booster Coils for Winter heating. Each zone or room has individual control of heating and cooling. Humidity is controlled both Summer and Winter.

Controls	Data Sheet
1. Reversible Damper Control Motor, Group DC-600	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Throttling Valve	V-80
4. Air Stream Thermostat	T-10
5. Throttling Valve	V-20, V-40, or V-80
6. Insertion Thermostat, fYDj 104	T-10
7. Reversible Damper Control Motor, Group DC-500, Cams A, Adj. Speed	DC-10
8. Solenoid Water Valve	V-120
9. Hygrostat, Insertion Type	H-10
10. Single Pole, Single Throw Relay, cYZp 1-1	A-10
11 and **12.** Combined as Two-Temperature, Summer-Winter Thermostat—one required for each room or zone	T-10
13. Insertion Thermostat, fYDj 104	T-10
14. Air Stream Thermostat	T-10
15. Hygrostat, Insertion Type	H-10
17. Special Double Pole, Double Throw Switch	A-10
18. Positive Damper Control Motor, Group DC-200 or DC-300—one required for each room or zone	DC-10
19. Static Pressure Regulator	
20. Reversible Damper Control Motor, Group DC-500, Adj. Speed	DC-10
22. Throttling Valve	V-80
23. Single Pole, Double Throw Switch, sYZe 3 or 4	A-10

CONTROL SYSTEM 114—Continued

DESCRIPTION OF OPERATION

Temperatures selected for illustration can, of course, be varied, but the same relative setting of the Thermostats must be used for proper functioning of the System.

Fresh Air Damper Control. Relay (2) controls Reversing Damper Control Motor (1), which in turn operates the combination Fresh Air and Recirculated Damper in such a manner that when the fan is running the Fresh Air Damper is opened at least to the minimum position, and when the fan is stopped the Fresh Air Damper is closed. The minimum position to which the Fresh Air Damper may be opened is usually 25% open, or that point which will admit only sufficient Fresh Air for ventilation. Automatic closing of the Fresh Air Damper prevents damage due to freezing when the system is not in operation. Switch (23) is provided so that the Fresh Air Damper may be closed, even though the fan is running, to permit rapid warm-up after a shutdown period, by the use of full recirculation.

When the temperature of the outside air is above 65 F, it has little or no cooling value; therefore, at 65 F, the setting of Thermostat (13), Damper Control Motor (1) is operated to close Fresh Air Damper to the minimum position.

When the temperature of the outside air is below 65 F, control of Damper Control Motor (1) is automatically shifted to Thermostat (14) to automatically proportion the Fresh Air and Recirculated Air. Air Stream Thermostat (14) is set at the lowest temperature desired in the fan discharge, usually about 60 F. It extends across the entire duct and controls from the average temperature in the plenum at this point. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (14).

This arrangement of control is most satisfactory, and increases the economy of the system by eliminating the necessity of running the cooling equipment in mild weather whenever, and as long as, the outside air has any value as a cooling medium.

Preheater Control. Air Stream Thermostat (4) set at 57 F operates Throttling Valve (3) to prevent the average temperature of the air entering the plenum dropping below 57 F. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (4). Because of the fact that the Reheater or tempering coil is placed in the Recirculated Air duct it is possible to use a Throttling Valve (3) without danger of freezing in the coils.

Humidity Control. *Heating Cycle.* Hygrostat (9) set at 30%, controls the operation of Solenoid Valve (8) to add moisture and maintain the desired relative humidity.

Cooling Cycle. Hygrostat (15) set at 55%, controls the operation of Relay (10) and will start the compressor at any time the humidity rises above this setting, and keep it running until the humidity is decreased.

Note:—Damper Control Motors (18) also control the operation of the compressor (to take care of the cooling requirements) but Hygrostat (15) has controlling preference whenever it is necessary to reduce the humidity.

Refrigeration Control. For the sake of simplicity, it is assumed that refrigeration is furnished by a compressor and direct expansion coils. (For control of other types of refrigeration see Part VI.) When Switch (17) is in the Winter position, the cooling equipment is cut out and cannot operate.

Cooling and Dehumidifying. When Switch (17) is in the Summer position, Throttling Valve (5) is run to the closed position and remains closed during the entire cooling period. The Compressor is controlled through Relay (10) by any one of Positive Damper Control Motors (18) as described under zone or room control.

By employing an interlocking circuit between Relay (10) and Reversible Damper Control Motor (1) the compressor can be prevented from starting whenever more than the minimum amount of Fresh Air is being admitted. This connection is optional but can be used to advantage where it is known that 65 F outside air will always give sufficient cooling. If the compressor should be required to operate even though Fresh Air at 65 F (or below) is being admitted, then this connection should not be used.

In order to reduce the humidity, Hygrostat (15) may operate Relay (10) and keep the compressor running even though all Damper Control Motors (18) are in the closed position. When all of the room dampers are closed the fan is delivering only approximately one-third of its capacity due to the action of the Static Pressure Regulator. Therefore, due to the lower velocity, the air is in contact with the cooling coils for a greater length of time, which provides more effective dehumidification. The result of discharging this small volume of dehumidified air into the rooms, is to lower the humidity without lowering the dry bulb temperature appreciably.

Reheater Control. When Switch (17) is in the Summer position, Throttling Valve (5) is run to the closed position, and remains closed, regardless of the position of the Face and By-pass Dampers.

Heating Cycle. When Switch (17) is in the Winter position, the cooling equipment is cut out and cannot operate. Thermostat (6) set at 70 F, operates Reversible Damper Control Motor (7), which in turn operates the Face and By-pass Damper to maintain the proper temperature of the air leaving the system. This is accomplished by regulating the amount of air by-passed under the coil and that passed through the coil. Upon continued demands for cooling all air is directed under the coil through the by-pass. In intermediate

CONTROL SYSTEM 114—Continued

positions accurate proportioning is obtained. Throttling Valve (5) on the steam line is controlled from the auxiliary switches in Damper Control Motor (7). The adjustable speed mechanism on both Damper Control Motor (7) and Throttling Valve (5) makes it possible to regulate the dampers and Valve, on the job, for a speed best suited to each individual installation. For detailed description of operation of Reheater, see Control System 104.

Static Pressure Control. Static Pressure Regulator (19) controls Reversing Damper Control Motor (20) which in turn operates the damper to regulate the amount of air entering the fan. In this way, any desired constant pressure is maintained in the discharge duct at all times, regardless of the number of zone or room dampers that are open.

Zone or Room Control. *Cooling Cycle.* Each Thermostat (11) controls its respective Positive Damper Control Motor (18) which in turn operates the shut-off damper to the zone or room. These dampers operate so that they are always in either the full open or closed position. In the closed position, the dampers will still admit air equal to about one-third of that admitted in the full open position, or that amount required for ventilation. On call for cooling, dampers open; on call for heat, dampers close.

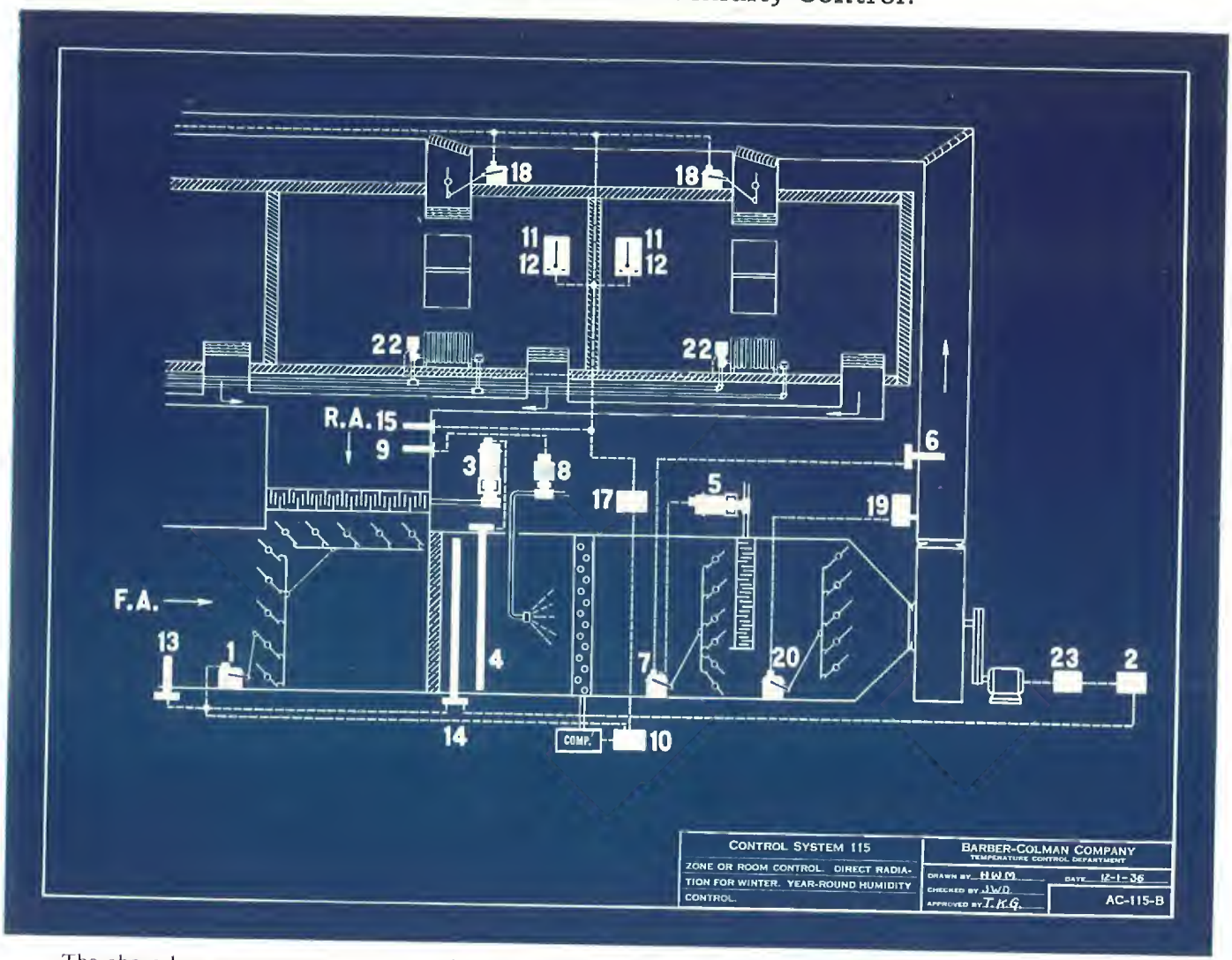
When all dampers are closed, compressor will stop; any one damper opening will cause compressor to start and continue running as long as one or more dampers are open.

Heating Cycle. When Switch (17) is turned to the Winter position, all damper Control Motors (18) are run to the full open position, the dampers remaining open during the entire heating cycle. Each Thermostat (12) controls a Throttling Valve (22) on the booster coil in the duct supplying each respective zone or room. Upon call for heat, Valve starts to open and continues opening until Thermostat is satisfied, or until the full open position is reached if the demand for heating persists. Upon call for cooling, the reverse action takes place, Valve closing until Thermostat is satisfied, or until the full closed position is reached. Valve stops in any position whenever Thermostat is satisfied, and is re-started in either direction to meet the demands for heating or cooling. For best results Valves (22) should be Throttling type; however, in some cases, if air distribution and diffusion of air in the rooms is ideal, Positive type Valves may be used with good results.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 115

Zone or Individual Room Control. Direct Radiation for Winter Heating. Summer and Winter Humidity Control.



The above layout represents a year-round Air Conditioning System similar to Control System 113, but with direct radiation for Winter heating. Each zone or room has individual control of heating and cooling both Summer and Winter.

Controls	Data Sheet
1. Reversible Damper Control Motor, Group DC-600	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Throttling Valve	V-80
4. Air Stream Thermostat	T-10
5. Throttling Valve	V-20, V-40, or V-80
6. Insertion Thermostat, fYDj 104	T-10
7. Reversible Damper Control Motor, Group DC-500, Cams A, Adj. Speed	DC-10
8. Solenoid Water Valve	V-120
9. Hygrostat, Insertion Type	H-10
10. Single Pole, Single Throw Relay, cYZp 1-1	A-10

Controls	Data Sheet
11 and **12.** Combined as Summer-Winter Two-Temperature Thermostat. One required for each room or zone	T-10
13. Insertion Thermostat, fYDj 104	T-10
14. Air Stream Thermostat	T-10
15. Hygrostat, Insertion Type	H-10
17. Special Double Pole, Double Throw Switch	A-10
18. Positive Damper Control Motor, Group DC-200 or DC-300. One required for each room or zone	DC-10
19. Static Pressure Regulator	
20. Reversible Damper Control Motor, Group DC-500, Adj. Speed	DC-10
22. Positive Valve	V-10 or V-20
23. Single Pole, Double Throw Switch, sYZe 3 or 4	A-10

CONTROL SYSTEM 115—Continued

DESCRIPTION OF OPERATION

Temperatures selected for illustration can, of course, be varied, but the same relative setting of the Thermostats must be used for proper functioning of the system.

Fresh Air Damper Control. Relay (2) controls Reversing Damper Control Motor (1), which in turn operates the combination Fresh Air and Recirculated Damper in such a manner that when the fan is running the Fresh Air Damper is opened at least to the minimum position and when the fan is stopped the Fresh Air Damper is closed. The minimum position to which the Fresh Air Damper may be opened is usually 25% open, or that point which will admit only sufficient Fresh Air for ventilation. Automatic closing of the Fresh Air Damper prevents possible damage due to freezing when the system is not in operation. Switch (23) is provided so that the Fresh Air Damper may be closed, even though the fan is running, to permit rapid warm-up after a shutdown period, by the use of full recirculation.

When the temperature of the outside air is above 65 F, it has little or no cooling value; therefore, at 65 F, the setting of Thermostat (13), Damper Control Motor (1) is operated to close Fresh Air Damper to the minimum position.

When the temperature of the outside air is below 65 F, control of Damper Control Motor (1) is automatically shifted to Thermostat (14) to automatically proportion the Fresh Air and Recirculated Air. Air Stream Thermostat (14) is set at the lowest temperature desired in the fan discharge, usually about 60 F. It extends across the entire duct and controls from the average temperature in the plenum at this point. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (14).

This arrangement of control is most satisfactory, and increases the economy of the system by eliminating the necessity of running the cooling equipment in mild weather whenever, and as long as, the outside air has any value as a cooling medium.

Preheater Control. Air Stream Thermostat (4) set at 57 F operates Throttling Valve (3) to prevent the average temperature of the air entering the plenum dropping below 57 F. Note: The Air Stream Thermostat is installed so that the sensitive element is in contact with all strata of air. If the arrangement of the duct is such that a thorough mixing of the Fresh Air and Recirculated Air is obtained before reaching the Thermostat, then a regular Insertion type Thermostat may be used in place of Air Stream Thermostat (4). Because of the fact that the Reheater or tempering coil is placed in the Recirculated Air duct it is possible to use a Throttling Valve (3) without danger of freezing in the coils.

Humidity Control. *Heating Cycle.* Hygrostat (9) set at 30%, controls the operation of Solenoid Valve (8) to add moisture and maintain the desired humidity.

Cooling Cycle. Hygrostat (15) set at 55%, controls the operation of Relay (10) and will start the compressor at any time the humidity rises above this setting, and keep it running until the humidity is decreased.

Note:—Damper Control Motors (18) also control the operation of the compressor (to take care of the cooling requirements) but Hygrostat (15) has controlling preference whenever it is necessary to reduce the relative humidity.

Refrigeration Control. For the sake of simplicity, it is assumed that refrigeration is furnished by a compressor and direct expansion coils (For control of other types of refrigeration, see Part VI.) When Switch (17) is in the Winter position, the cooling equipment is cut out and cannot operate.

Cooling and Dehumidifying. When Switch (17) is in the Summer position, Throttling Valve (5) is run to the closed position and remains closed during the entire cooling period. The compressor is controlled through Relay (10) by any one of Positive Damper Control Motors (18) as described under zone or room control.

By employing an interlocking circuit between Relay (10) and Reversible Damper Control Motor (1) the compressor can be prevented from starting whenever more than the minimum amount of Fresh Air is being admitted. This connection is optional, but can be used to advantage where it is known that 65 F outside air will always give sufficient cooling. If the compressor should be required to operate even though Fresh Air at 65 F (or below) is being admitted, then this connection should not be used.

In order to reduce the relative humidity, Hygrostat (15) may operate Relay (10) and keep the compressor running even though all Damper Control Motors (18) are in the closed position. When all of the room dampers are closed to the minimum position the fan is delivering only approximately one-third of its capacity, due to the action of the Static Pressure Regulator. Therefore, due to the lower velocity, the air is in contact with the cooling coils for a greater length of time, which provides more effective dehumidification. The result of discharging this small volume of dehumidified air into the rooms, is to lower the humidity without lowering the dry bulb temperature appreciably.

Reheater Control. When Switch (17) is in the Summer position, Throttling Valve (5) is run to the closed position, and remains closed, regardless of the position of the Face and By-pass Dampers.

CONTROL SYSTEM 115—Continued

Heating Cycle. When Switch (17) is in the Winter position, the cooling equipment is cut out and cannot operate. Thermostat (6), set at 70 F, operates Reversible Damper Control Motor (7), which in turn operates the Face and By-pass Damper to maintain the proper temperature of the air leaving the system. This is accomplished by regulating the amount of air by-passed under the coil and that passed through the coil. Upon continued demands for heating all air is directed through the coil; upon continued demands for cooling all air is directed under the coil through the by-pass. In intermediate positions accurate proportioning is obtained. Throttling Valve (5) on the steam line is controlled from the auxiliary switches in Damper Control Motor (7). The adjustable speed mechanism on both Damper Control Motor (7) and Throttling Valve (5) makes it possible to regulate the dampers and Valve, on the job, for a speed best suited to each individual installation. For detailed description of operation of Reheater, see Control System 104.

Static Pressure Control. Static Pressure Regulator (19) controls Reversing Damper Control Motor (20) which in turn operates the damper to regulate the amount of air entering the fan. In this way, any desired constant pressure is maintained in the discharge duct at all times, regardless of the number of zone or room dampers that are open.

Zone or Room Control. *Cooling Cycle.* Each Thermostat (11) controls its respective Positive Damper Control Motor (18) which in turn operates the shut-off damper to the zone or room. These dampers operate so that they are always in either the full open or closed position. In the closed position, the dampers will still admit air equal to about one-third of that admitted in the full open position, or that amount required for ventilation. On call for cooling, dampers open; on call for heat, dampers close.

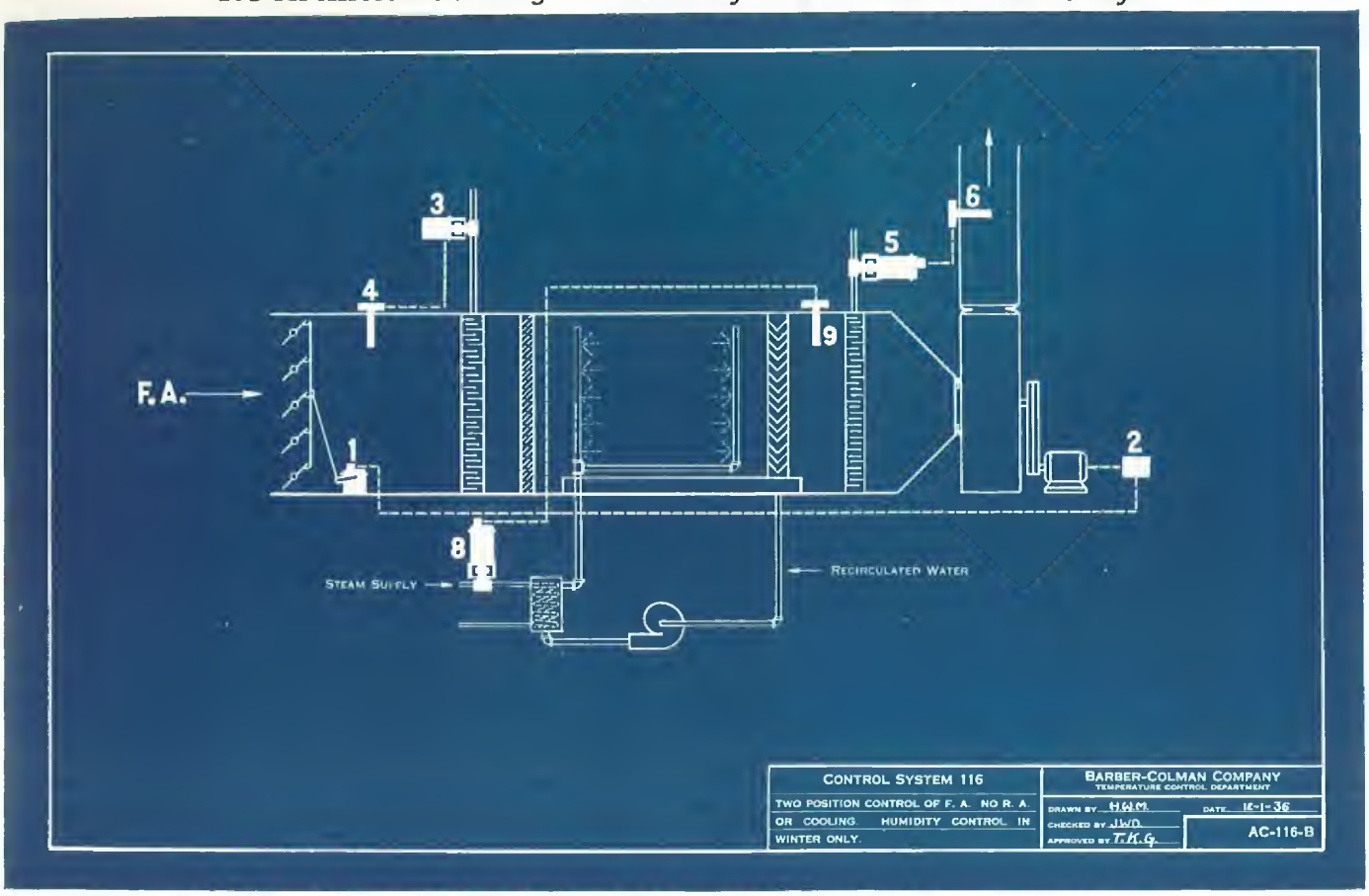
When all dampers are closed, compressor will stop; any one damper opening will cause compressor to start and continue running as long as one or more dampers are open.

Heating Cycle. When Switch (17) is turned to the Winter position, all Damper Control Motors (18) are run to the full open position, the dampers remaining open during the entire heating cycle. Each Thermostat (12) controls its respective Positive Zone or Radiator Valve (22) in such a manner that on a call for heat, Valves open, and on a call for cooling, Valves close.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 116

Two-Position Control of Fresh Air Damper. No Recirculated Air. No Artificial Cooling. Humidity Control in Winter Only.



The above layout represents a simple Air Washer System using all Fresh Air. Unless the water is artificially cooled the air washer should not be used in Summer except in localities where the wet bulb temperature is low enough to effect sufficient evaporative cooling from the water in the washer and still avoid excessive humidity in the conditioned space.

Controls	Data Sheet
1. Unidirectional Damper Control Motor, Group DC-200	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Positive Valve	V-20 or V-40
4. Insertion Thermostat, fYDj 103	T-10
5. Throttling Valve	V-80
6. Insertion Thermostat, fYDj 104	T-10
8. Throttling Valve	V-80
9. Corrosion Resistant Insertion Thermostat, fYDj 164	T-10

DESCRIPTION OF OPERATION

Temperatures selected for illustration can, of course, be varied, but the same relative setting of the Thermostats must be used for proper functioning of the system.

Fresh Air Damper Control. Relay (2) controls Damper Control Motor (1), which in turn operates the Fresh Air Damper in such a manner that when the fan is running the damper is open, and when the fan is stopped the damper is closed. Automatic closing of the damper prevents cold air reaching the tempering coils, and possible damage due to freezing when the system is not in operation.

Preheater Control. Thermostat (4) set at 35 F opens Positive Valve (3) on the steam line to the Preheater whenever the outdoor temperature drops below 35 F, thus avoiding a possibility of freezing in the coils.

Humidity Control. *Heating Cycle.* Humidity is maintained in the conditioned space by controlling the dew point temperature of the air leaving the air washer. The air being saturated at the dew point temperature will, of course, have a definite relative humidity when reheated to any higher temperature. Therefore, it is only necessary to control the dew point temperature with Thermostat (9) to maintain the desired relative humidity of the air leaving the system. For example, Thermostat (9) set at 40 F will maintain the relative humidity of the air leaving the system at approximately 34% when reheated to 70 F, or approximately 30% in the conditioned space (allowing 4% for loss). This is a very simple method, and is accomplished by operating Throttling Valve (8) on the steam line to an indirect heater which regulates the temperature of the water to the washer.

Upon call for heat, Valve starts to open, and continues opening until Thermostat (9) is satisfied, or until the full open position is reached if the demand for heating persists.

Upon call for cooling, the reverse action takes place, Valve closing until Thermostat (9) is satisfied, or until the full closed position is reached. Valve will stop and remain in any position whenever, and as long as, Thermostat is satisfied; it may be restarted in either direction to satisfy the demands for heating or cooling.

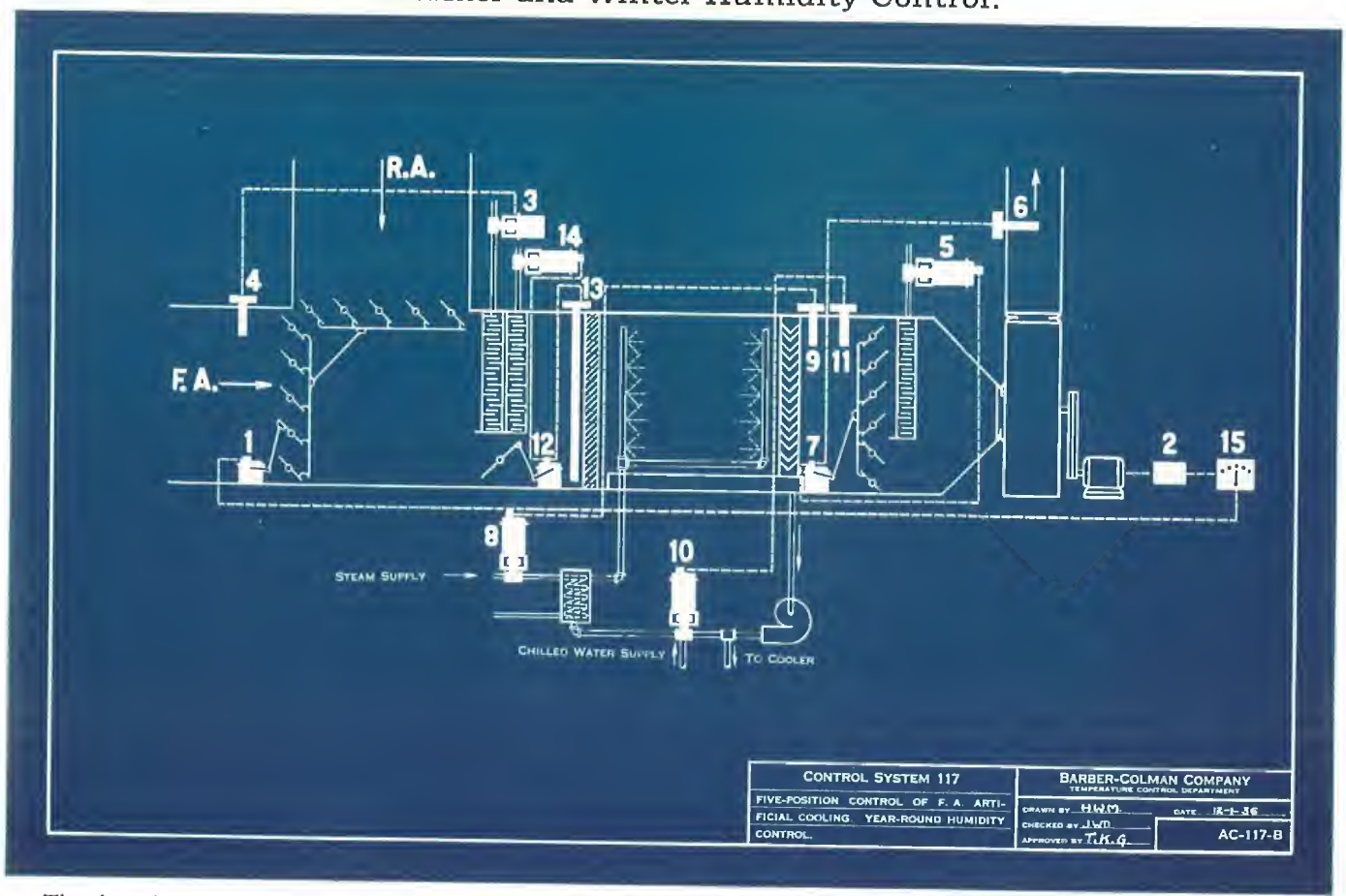
Cooling Cycle. The air washer should be shut off when the outdoor wet bulb temperature rises above the point where evaporative cooling from the water in the air washer is not sufficient to hold the dew point temperature of the air leaving the washer low enough to prevent excessive humidity in the conditioned space.

Reheater Control. *Heating Cycle.* Thermostat (6) set at 70 F, operates Throttling Valve (5) on steam line to the Reheater, so as to maintain a constant temperature of the air leaving the system.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 117

Five-Position Control of Fresh Air Damper. Automatic Control of By-pass Dampers under Preheater and Reheater. Artificial Cooling. Summer and Winter Humidity Control.



The above layout represents an Air Washer System similar to Control System 116 with the addition of selective positioning of the Fresh Air and Recirculated Air Dampers, artificial cooling of the water, and By-pass under Preheater and Reheater coils.

Controls	Data Sheet
1. Unidirectional Damper Control Motor, Group DC-600	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Positive Valve	V-20 or V-40
4. Insertion Thermostat, fYDj 103	T-10
5. Throttling Valve	V-20, V-40 or V-80
6. Insertion Thermostat, fYDj 104	T-10
7. Reversible Damper Control Motor, Group DC-500, Cams A, Adj. Speed	DC-10
8. Throttling Valve	V-80
9. Corrosion Resistant Insertion Thermostat, fYDj 163	T-10
10. Three-Way Valve, Throttling Type	V-100
11. Corrosion Resistant Insertion Thermostat, fYDj 163	T-10
12. Reversible Damper Control Motor, Group DC-500, Cams A, Adj. Speed	DC-10
13. Air Stream Thermostat	T-10
14. Throttling Valve	V-20, V-40 or V-80
15. 5-Point Switch, cYZe 921 or 922	A-10

DESCRIPTION OF OPERATION

Temperatures selected for illustration can, of course, be varied, but the same relative setting of the Thermostats must be used for proper functioning of the system.

Fresh Air Damper Control. Relay (2) controls Damper Control Motor (1), which in turn operates the Fresh Air Damper in such a manner that when the fan is running the damper is placed in one of its open positions, and when the fan is stopped the damper is closed. Automatic closing of the damper prevents cold air reaching the tempering coils, and possible damage due to freezing when the system is not in operation.

The open position of the Fresh Air Damper is determined by the setting of the 5-Point Switch. The usual arrangement of these five positions, expressed in per cent of full opening, is 0, 25, 50, 75 and 100. Selection, or the changing, of the position of the Fresh Air Damper makes it possible to regulate the amount of Fresh Air.

If multi-position control of the Fresh Air Damper is desired, a Microrelay should be added, Microtrol substituted for the 5-Position Damper Control Motor, and a Rheostat used in place of the 5-Point Switch.

CONTROL SYSTEM 117—Continued

With this combination, the Fresh Air Damper may be positioned exactly in accordance with the position selected by the Rheostat.

Recirculated Air Damper Control. The Recirculated Air Damper is connected to the Fresh Air Damper in such a way that when the Fresh Air Damper is fully open the Recirculated Air Damper is fully closed, and vice versa. Intermediate positions are proportional.

Preheater Control. *First Coil.* Thermostat (4) set at 35 F opens Positive Valve (3) on the steam line to the Preheater whenever the outdoor temperature drops below 35 F, thus avoiding a possibility of freezing in the coils.

Second Coil. Air Stream Thermostat (13) is installed so that the sensitive element is in contact with the air coming through the by-pass, as well as with that coming through the coils. It is set at 40 F and operates Reversible Damper Control Motor (12), which in turn operates the By-pass Damper to maintain a constant temperature of the air entering the air washer. The operation of Throttling Valve (14) on the steam line is controlled from the auxiliary switches in Damper Control Motor (12). Damper Control Motor (12) always regulates the temperature as far as possible by the operation of the By-pass Damper; Valve (14) operates only when necessary to supply more or less heat after the damper has reached its maximum heating or cooling position.

Upon call for heat, Damper Control Motor (12) starts to close By-pass Damper. If the demand for heat continues after damper has reached the maximum heating position (by-pass closed) then Throttling Valve (14) starts to open, and continues to open until Thermostat (13) is satisfied.

Upon call for less heat, Throttling Valve (14) does not change its position, the cooling being accomplished by Damper Control Motor (12) regulating the By-pass Damper. However, when the damper reaches the full cooling position (by-pass open) and there is demand for additional cooling, then Throttling Valve (14) starts to close, and continues to close until Thermostat (13) is satisfied.

The adjustable speed mechanism on both Damper Control Motor (12) and Throttling Valve (14) makes it possible to regulate the damper and Valve, on the job, for a speed best suited to each individual installation.

Humidity Control. *Heating Cycle.* Humidity is maintained in the conditioned space by controlling the dew point temperature of the air leaving the air washer. The air being saturated at the dew point temperature, will of course have a definite relative humidity when reheated to any higher temperature. Therefore, it is only necessary to control the dew point temperature with Thermostat (9) to maintain the desired relative humidity of the air leaving the system. For example, Thermostat (9) set at 40 F will maintain the relative humidity of the air leaving the system at approximately 34%, when reheated to 70 F, or approximately 30% in the conditioned space (allowing 4% for loss). This is a very simple method and is accomplished by operating Throttling Valve (8) on the steam line to an indirect heater which regulates the temperature of the water to the washer.

Upon call for heat, Valve starts to open, and continues opening until Thermostat (9) is satisfied, or until the full open position is reached if the demand for heating persists.

Upon call for cooling, the reverse action takes place, Valve closing until Thermostat (9) is satisfied, or until the full closed position is reached. Valve will stop and remain in any position whenever, and as long as, Thermostat is satisfied; it may be restarted in either direction to satisfy the demands for heating or cooling.

Cooling Cycle. When the outdoor wet bulb temperature rises above the point where evaporative cooling from the water in the air washer is not sufficient to hold the dew point temperature at or below 40 F, then Thermostat (9) will of course be calling for cooling and keep Valve (8) closed. As the dew point temperature rises to 50 F, then Thermostat (11) starts to operate Three-way Valve (10), admitting the proper proportion of chilled water and recirculated water to maintain a dew point temperature of 50 F. Three-way Valve (10) operates in such a manner that on a continued call for heat, the Valve admits all recirculated water; and on a continued call for cooling, the Valve admits all chilled water. In intermediate positions, accurate proportioning is obtained. The Valve Operator is of the Throttling type, and may be stopped in any position (when demands for heating and cooling are satisfied) and re-started in either direction. Valve (8) will, of course, be closed whenever chilled water is being circulated because the setting of Thermostat (9) is lower than the setting of Thermostat (11), and similarly no chilled water will be circulated when Valve (8) is open.

In case it is desired to have the differential between Thermostat (9) and Thermostat (11) very small, Valve (10) is prevented from admitting any chilled water when Valve (8) is open, and vice versa, by wiring Valve (10) through the interlock switches in the Valve Operator on Valve (8). However, with the average Air Conditioning System which is installed for comfort only, the differential between the settings of these Thermostats will be at least 10 degrees, as it is desirable to maintain a considerably lower dew point temperature in Winter to eliminate excessive window condensation.

Refrigeration Control. The chilled water may be obtained directly from a deep well water supply, ice bunker, or chilled by either mechanical or steam jet refrigeration. (For control of various types of refrigeration see Part VI).

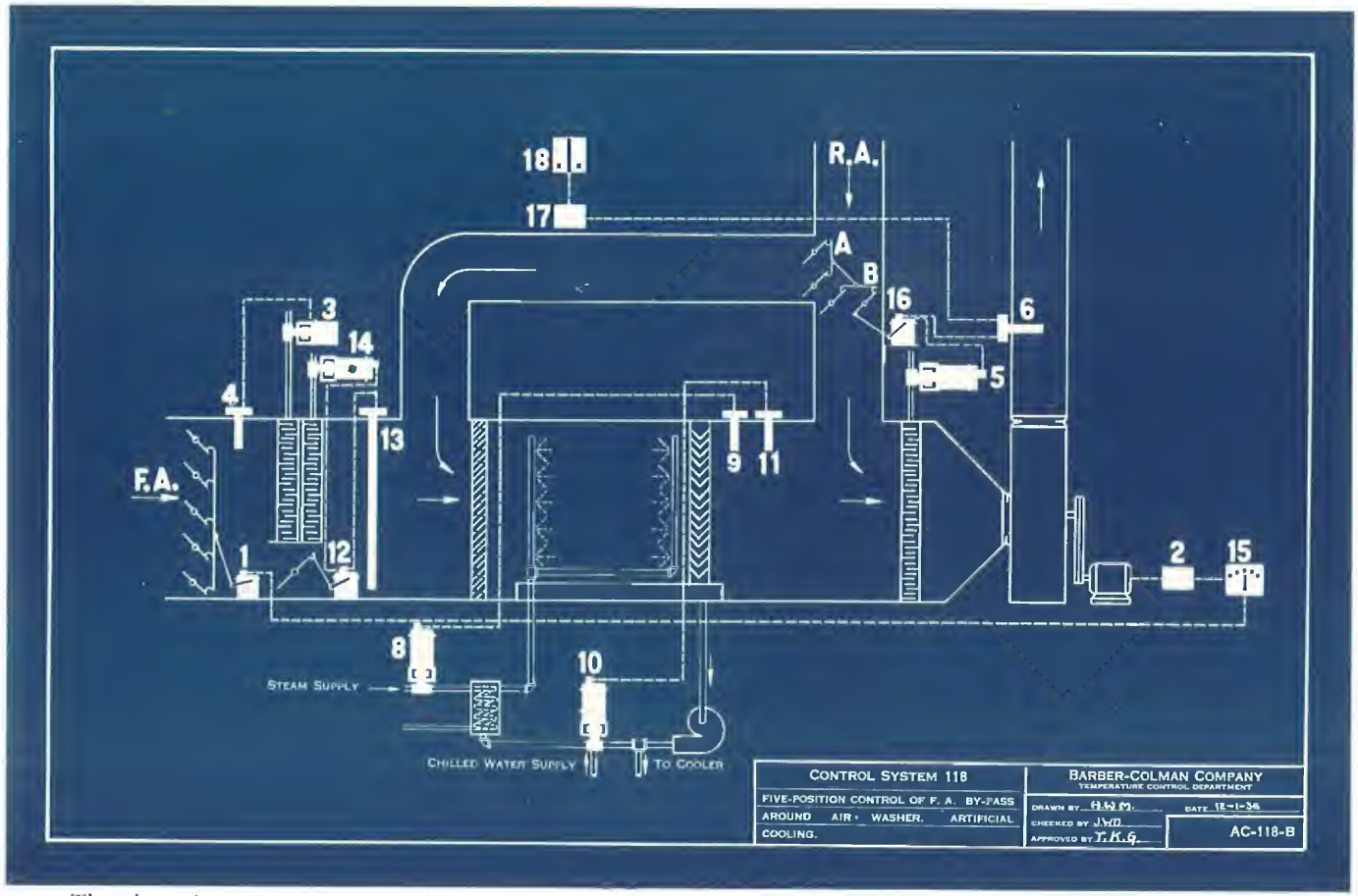
Reheater Control. Thermostat (6) operates Reversible Damper Control Motor (7) which in turn operates the Face and By-pass Damper to maintain a constant temperature of the air leaving the system. Thermostat (6) is set at 70 F during the heating cycle, and reset to a lower temperature during the cooling cycle. The adjustable speed mechanism on Damper Control Motor (7) makes it possible to regulate the damper, on the job, for a speed best suited for each individual installation.

For detailed description of operation of Reheater see Control System 104.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 118

Five-Position Control of Fresh Air Damper. Automatic By-pass Around Air Washer. Artificial Cooling. Summer and Winter Humidity Control.



The above layout represents an Air Washer System similar to Control System 117 with the addition of automatic By-pass around the air washer.

Controls	Data Sheet
1. Unidirectional Damper Control Motor, Group DC-600	DC-10
2. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
3. Positive Valve	V-20 or V-40
4. Insertion Thermostat, fYDj 103	T-10
5. Microvalve	V-20, V-40 or V-80
6. Insertion Thermostat, fYDj 103	T-10
8. Throttling Valve	V-80
9. Corrosion Resistant Insertion Thermostat, fYDj 163	T-10
10. Three-Way Valve, Throttling Type	V-100
11. Corrosion Resistant Insertion Thermostat, fYDj 163	T-10
12. Reversible Damper Control Motor, Group DC-500, Cams A, Adj. Speed	DC-10
13. Air Stream Thermostat	T-10
14. Throttling Valve	V-20, V-40 or V-80
15. 5-Point Switch, cYZe 921 or 922	A-10
16. Microtrol	DC-10
17. Double Pole, Double Throw Switch, sYZe 5 or 6	A-10
18. Microtherm	T-10

DESCRIPTION OF OPERATION

Temperatures selected for illustration can, of course, be varied, but the same relative setting of the Thermostats must be used for proper functioning of the system.

Fresh Air Damper Control. Relay (2) controls Damper Control Motor (1), which in turn operates the Fresh Air Damper in such a manner that when the fan is running the damper is placed in one of its open positions, and when the fan is stopped the damper is closed. Automatic closing of the damper prevents cold air reaching the tempering coils, and possible damage due to freezing when the system is not in operation.

The open position of the Fresh Air Damper is determined by the setting of the 5-Point Switch. The usual arrangement of these five positions, expressed in per cent of full opening, is 0, 25, 50, 75, and 100. Selection, or the changing, of the position of the Fresh Air Damper makes it possible to take advantage of seasonal or extreme weather conditions, and also per-

CONTROL SYSTEM 118—Continued

mits rapid warm-up after a shut down period, by the use of full recirculation.

If multi-position control of the Fresh Air Damper is desired, a Microrelay should be added, Microtrol substituted for the 5-Position Damper Control Motor, and a Rheostat used in place of the 5-Point Switch. With this combination the Fresh Air Damper may be positioned exactly in accordance with the position selected by the Rheostat.

Preheater Control. *First Coil.* Thermostat (4) set at 35 F opens Positive Valve (3) on the steam line to the Preheater whenever the outdoor temperature drops below 35 F, thus avoiding a possibility of freezing in the coils.

Second Coil. Air Stream Thermostat (13) set at 40 F, operates Reversible Damper Control Motor (12), which in turn operates the By-pass Damper to maintain a constant temperature of the air entering the air washer. The operation of Throttling Valve (14) on the steam line is controlled from the auxiliary switches in Damper Control Motor (12). Damper Control Motor (12) always regulates the temperature as far as possible by the operation of the By-pass Damper; Valve (14) operates only when necessary to supply more or less heat after the damper has reached its maximum heating or cooling position.

Upon call for heat, Damper Control Motor (12) starts to close By-pass Damper. If the demand for heat continues after damper has reached the maximum heating position (by-pass closed) then Throttling Valve (14) starts to open, and continues to open until Thermostat (13) is satisfied.

Upon call for less heat, Throttling Valve (14) does not change its position, the cooling being accomplished by Damper Control Motor (12) regulating the By-pass Damper. However, when the damper reaches the full cooling position (by-pass open) and there is demand for additional cooling, then Throttling Valve (14) starts to close, and continues to close until Thermostat (13) is satisfied.

The adjustable speed mechanism on both Damper Control Motor (12) and Throttling Valve (14) makes it possible to regulate the damper and Valve, on the job, for a speed best suited to each individual installation.

Humidity Control. *Heating Cycle.* Humidity is maintained in the conditioned space by controlling the dew point temperature of the air leaving the air washer. The air being saturated at the dew point temperature will of course have a definite relative humidity when reheated to any higher temperature. Therefore, it is only necessary to control the dew point temperature with Thermostat (9) to maintain the desired relative humidity of the air leaving the system. For example, Thermostat (9) set at 40 F will maintain the relative humidity of the air leaving the system at approximately 34%, when reheated to 70 F, or approximately 30% in the conditioned space (allowing 4% for loss). This is a very simple method and is accomplished by operating Throttling Valve (8) on the steam line to an indirect heater which regulates the temperature of the water to the washer.

Upon call for heat, Valve starts to open, and continues opening until Thermostat (9) is satisfied, or until the full open position is reached if the demand for heating persists. Upon call for cooling, the reverse action takes place, Valve closing until Thermostat (9) is satisfied, or until the full closed position is reached. Valve will stop and remain in any position whenever, and as long as, Thermostat is satisfied; it may be restarted in either direction to satisfy the demands for heating or cooling.

Cooling Cycle. When the outdoor wet bulb temperature rises above the point where the evaporative cooling from the water in the air washer is not sufficient to hold the dew point temperature at or below 40 F then Thermostat (9) will of course be calling for cooling and keep Valve (8) closed. As the dew point temperature rises to 50 F, then Thermostat (11) starts to operate Three-way Valve (10), admitting the proper proportion of chilled water and recirculated water to maintain a dew point temperature of 50 F. Three-way Valve (10) operates in such a manner that on a continued call for heat, the Valve admits all recirculated water; and on a continued call for cooling, the Valve admits all chilled water. In intermediate positions, accurate proportioning is obtained. The Valve Operator is of the Throttling type, and may be stopped in any position (when demands for heating and cooling are satisfied) and restarted in either direction. Valve (8) will, of course, be closed whenever chilled water is being circulated because the setting of Thermostat (9) is lower than the setting of Thermostat (11), and similarly no chilled water will be circulated when Valve (8) is open.

In case it is desired to have the differential between Thermostat (9) and Thermostat (11) very small, Valve (10) is prevented from admitting any chilled water when Valve (8) is open, and vice versa, by wiring Valve (10) through the interlock switches in the Valve Operator on Valve (8). However, with the average air conditioning system, which is installed for comfort only, the differential between the settings of these Thermostats will be at least 10 degrees, as it is desirable to maintain a considerably lower dew point temperature in Winter to eliminate excessive window condensation.

Refrigeration Control. The chilled water may be obtained directly from a deep well water supply, ice bunker, or chilled by either mechanical or steam jet refrigeration. (For control of various types of refrigeration see Part VI).

Reheater and By-pass Control. *Heating Cycle.* Microtherm (18) set at 70 F, operates Microtrol (16) and Microvalve (5) to maintain a constant room temperature. Microtrol (16) operates the combination By-pass Dampers (A) and (B) to regulate the amount of recirculated air directed through the air washer or by-passed around it. Dampers (A) and (B) are linked together in such a way that when Damper (A) is open, Damper (B) is closed, and vice versa. Microvalve (5) on the steam line to the Reheater is controlled from the auxiliary switches in Microtrol (16). Microtrol (16) and Microvalve (5) operate in reversing series; i.e.,

CONTROL SYSTEM 118—Continued

upon continued demands for heating, Microtrol (16) operates dampers to the full heating position (A open, B closed) then Microvalve (5) opens; upon continued demands for cooling the reverse action takes place, Microvalve (5) closing first, then dampers operating to the full cooling position (A closed, B open). The above action is interrupted whenever, and as long as, Microtherm (18) and Thermostat (6) are satisfied, action being resumed whenever necessary to meet demands for either heating or cooling.

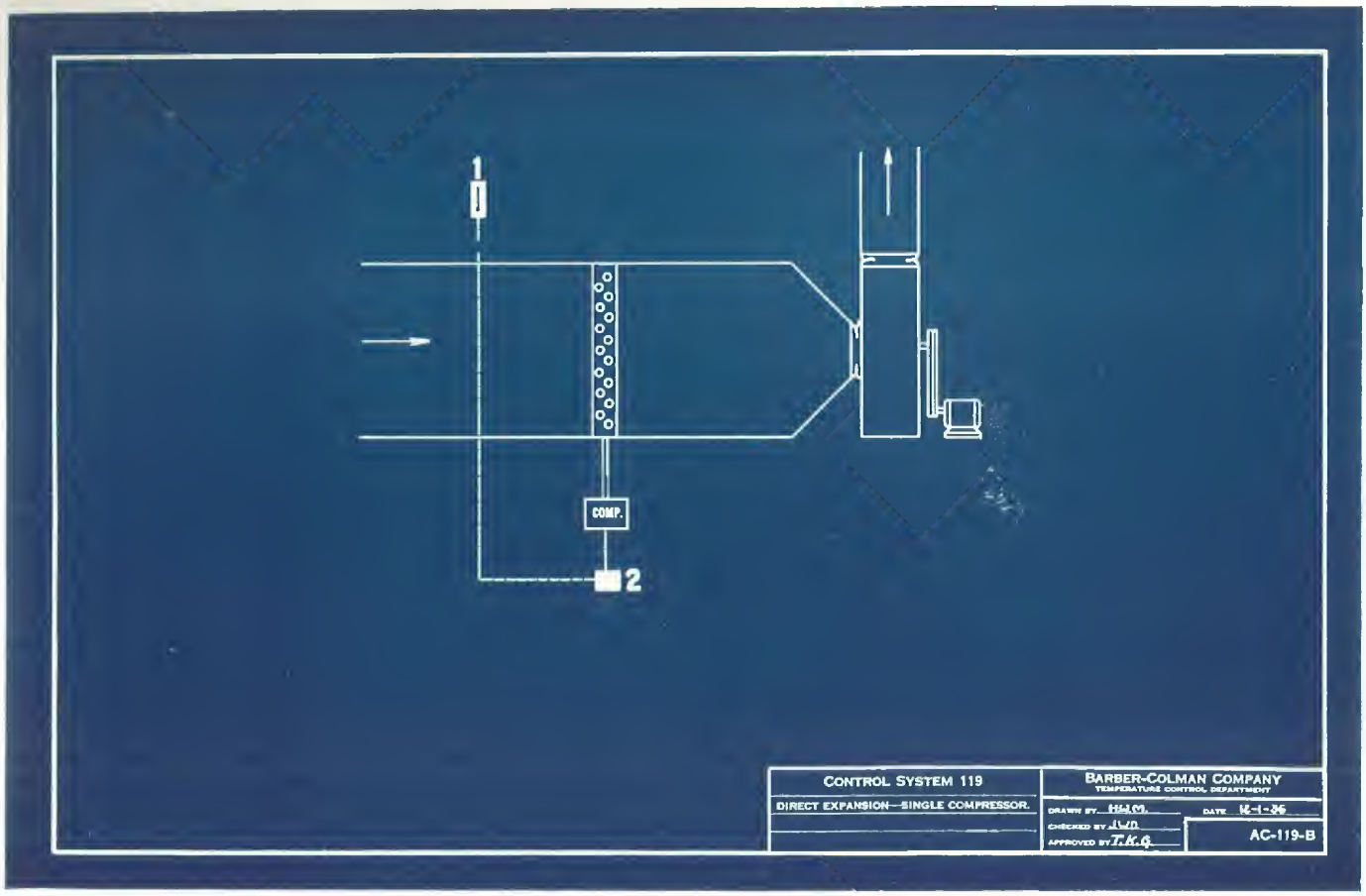
Thermostat (6) operates Microtrol (16) and Throttling Valve (5) in the same manner as Microtherm (18) but independently of it. It acts as a low limit to prevent the temperature of the air in the fan discharge ever dropping below 60 F. In this way the possibility of cold drafts is eliminated, should there be a sudden cooling load during the heating season.

Cooling Cycle. The operation is essentially the same as described under heating cycle, except that all reheating is furnished by recirculating by-passed Air, Valve (5) being wired through the Summer-Winter Switch (17) so that it will not open, even should Microtrol (16) run Damper (A) to the wide open position. In Summer operation, a heating demand in excess of that which can be satisfied by the by-passed Recirculated Air through Damper (A) is so seldom encountered, and would usually be of such short duration, that steam for reheating is not required and additional economy is obtained by keeping Valve (5) closed. If, however, additional heat should be required, Valve (5) may be wired to open the same as it does during Winter operation.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 119

Direct Expansion—Single Compressor.



The above layout illustrates the control of a single compressor.

Controls	Data Sheet
1. Thermostat, YDa 291	T-10
2. Single Pole, Single Throw Relay, cYZp 1-1	A-10

DESCRIPTION OF OPERATION

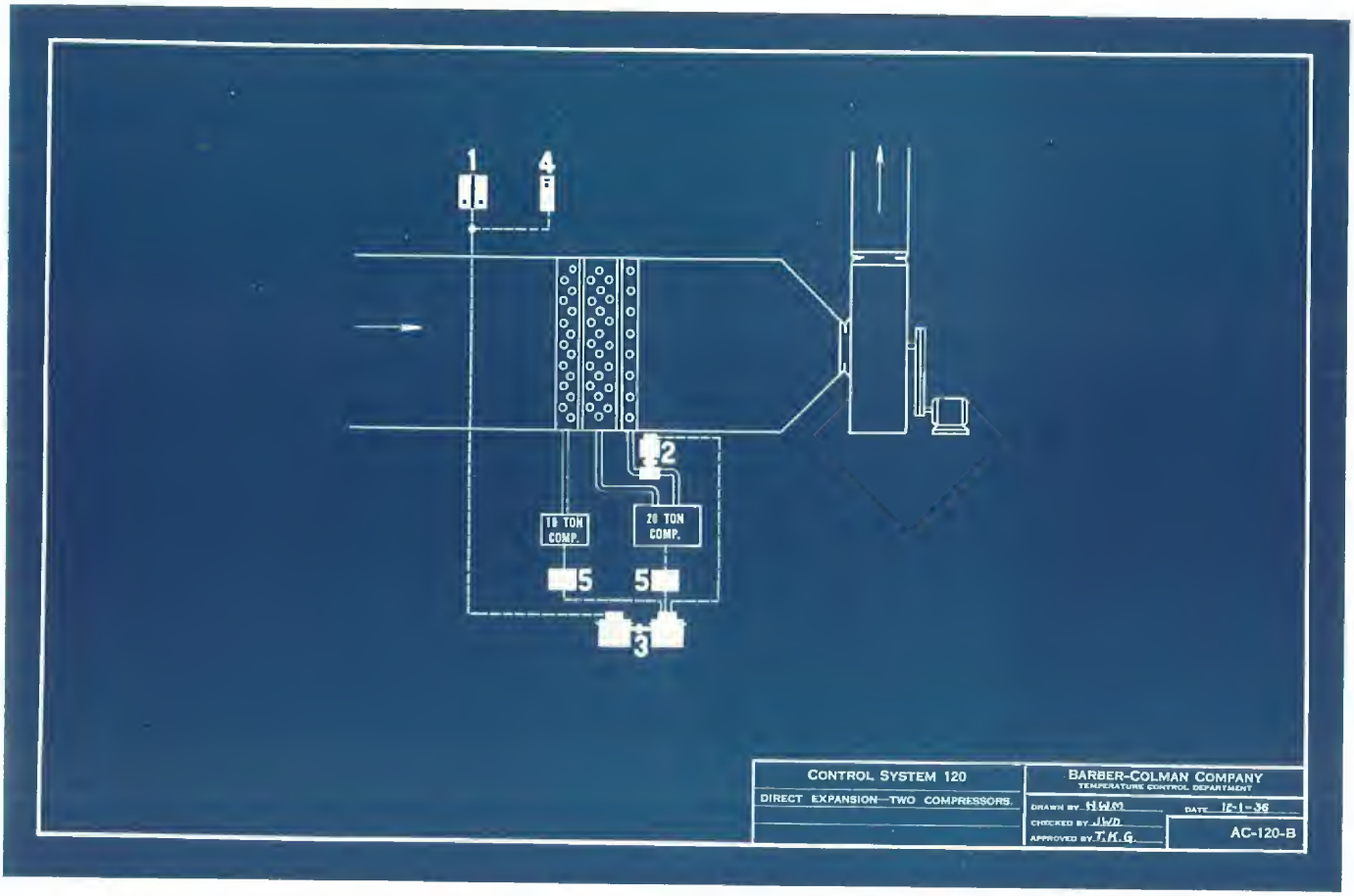
Thermostat (1) controls the operation of the compressor through Relay (2) to maintain the desired room temperature. On call for cooling, compressor starts and continues to run until Thermostat is satisfied.

The motor starter furnished with the compressor motor must of course be used in addition to Relay (10).

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 120

Direct Expansion—Two Compressors.



The above layout illustrates two compressors of different sizes controlled in such a manner that five different capacities are available.

Controls	Data Sheet
1. Microtherm	T-10
2. Solenoid Refrigerant Valve	V-120
3. Progressive Compressor Control Program Switch with Microtrol Driving Unit	DC-10
4. Hygrostat	H-10
5. Double Pole, Double Throw Relay. Two required	A-10

DESCRIPTION OF OPERATION

For purpose of illustration we shall describe this Control System using 10 and 20-ton compressors.

Temperature Control. Microtherm (1) controls the operation of Program Switch (3) which in turn regulates the operation of the compressors to maintain the desired room temperature.

On demand for cooling, Microtherm (1) starts Program Switch (3) which in turn starts the 10-ton compressor. If the demand continues, the 10-ton compressor is cut off and the 20-ton compressor started, with Solenoid Valve (2) in the closed position, giving 15-ton capacity. Upon further demand for cooling, Solenoid Valve (2) opens, giving 20-ton capacity. If the demand continues, Solenoid Valve (2) is closed and the 10-ton compressor restarted, giving 25-ton capacity. Finally, if the demand still continues, Solenoid Valve (2) re-opens, giving 30-ton capacity. On call for less cooling, the reverse action takes place.

The following table shows the sequence of operation:

Steps	Capacity Available	10-Ton Compressor	20-Ton Compressor	Solenoid Valve (2)
1st	10 Tons	On	Off	Closed
2nd	15 Tons	Off	On	Closed
3rd	20 Tons	Off	On	Open
4th	25 Tons	On	On	Closed
5th	30 Tons	On	On	Open

Humidity Control. Hygrostat (6) also controls the operation of Program Switch (3) and is so wired that it has controlling preference over Microtherm (1) and will keep the compressors running whenever, and as long as, necessary to maintain the desired relative humidity.

Compressor Control. The 20-ton compressor is connected to two separate sets of coils, one of approximately 15-ton capacity, and the other 5-ton capacity. Solenoid Valve (2), installed on the liquid line to the smaller coil, cuts off approximately 5-ton capacity when it is closed. When it is open, full capacity of the 20-ton compressor is permitted.

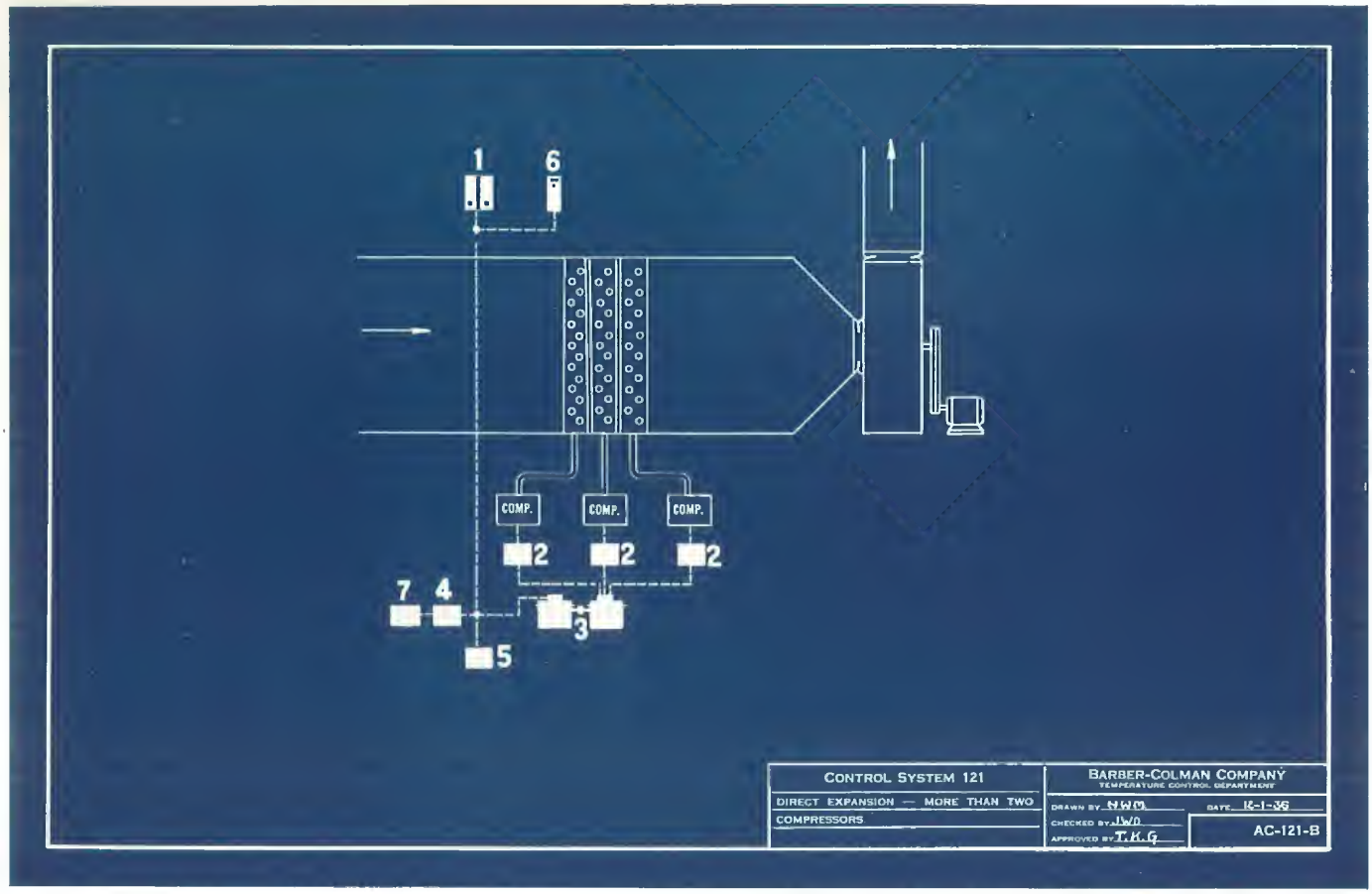
Program Switch (3) is driven by a reversing motor which may be stopped in any position whenever Microtherm (1) is satisfied, and restarted in either direction to meet demands for more or less cooling. In the "off" position both compressors are stopped. The motor drives a series of cam-operated switches so as to start or stop the compressors, or open or close Solenoid Valve (2), in the desired sequence with predetermined intervals. An adjustable speed mechanism makes it possible to regulate the Program Switch so that its speed of operation will be best suited to each individual installation.

This system permits the greatest flexibility with maximum economy and the minimum of equipment.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 121

Direct Expansion—More than Two Compressors.



The above layout illustrates the control of three compressors in such a manner that the number of operating compressors are increased or decreased automatically to meet requirements. Also their sequence of operation is reversed every 12 hours so as to equalize the wear on the compressors. Any number of compressors can be controlled in this manner.

Controls	Data Sheet
1. Microtherm	T-10
2. Single Pole, Single Throw Relay, cYZp 1-1. One required for each compressor	A-10
3. Selective Compressor Control Program Switch with Microtrol Driving Unit	DC-10
4. Special Relay. Three normally open and one normally closed contacts	A-10
5. Time Switch, 25 Volt Motor, bYZp 4	A-10
6. Hygrostat	H-10
7. Single Pole, Single Throw Switch, sYZe 1 or 2	A-10

DESCRIPTION OF OPERATION

Temperature Control. Microtherm (1) controls the operation of Program Motor (3) which in turn regulates the operation of the compressors to maintain the desired room temperature.

On demand for cooling, Microtherm (1) starts Program Switch (3), which in turn starts the first compressor. If the demand increases, the second and third compressors will start after predetermined intervals. When Microtherm (1) is satisfied, Program Switch (3) stops, allowing the compressors that have been started to continue to run. On demand for less cooling, Program Switch (3) runs in the reverse direction to stop one or more of the compressors, or all of them, if the demand continues.

Humidity Control. Hygrostat (6) also controls the operation of Program Switch (3) and is so wired that it has controlling preference over Microtherm (1) and will keep the compressors running whenever, and as long as, necessary to maintain the desired relative humidity.

Compressor Control. Program Switch (3) is driven by a reversing motor which may be stopped in any position whenever Microtherm (1) is satisfied, and restarted in either direction to meet demands for more or less cooling. In the "off" position all compressors are stopped. The motor drives a series of cam-operated switches so as to start or stop the compressors in progressive sequence with predetermined minimum intervals. The speed of this motor is adjustable so as to permit the proper adaptation to individual installations.

In the event of current failure, Relay (4) is de-energized and all compressors will be stopped. Upon resumption of current, Program Switch (3) will first return to the "off" position before permitting Relay (4) to be re-energized and the compressors to be started in their normal sequence.

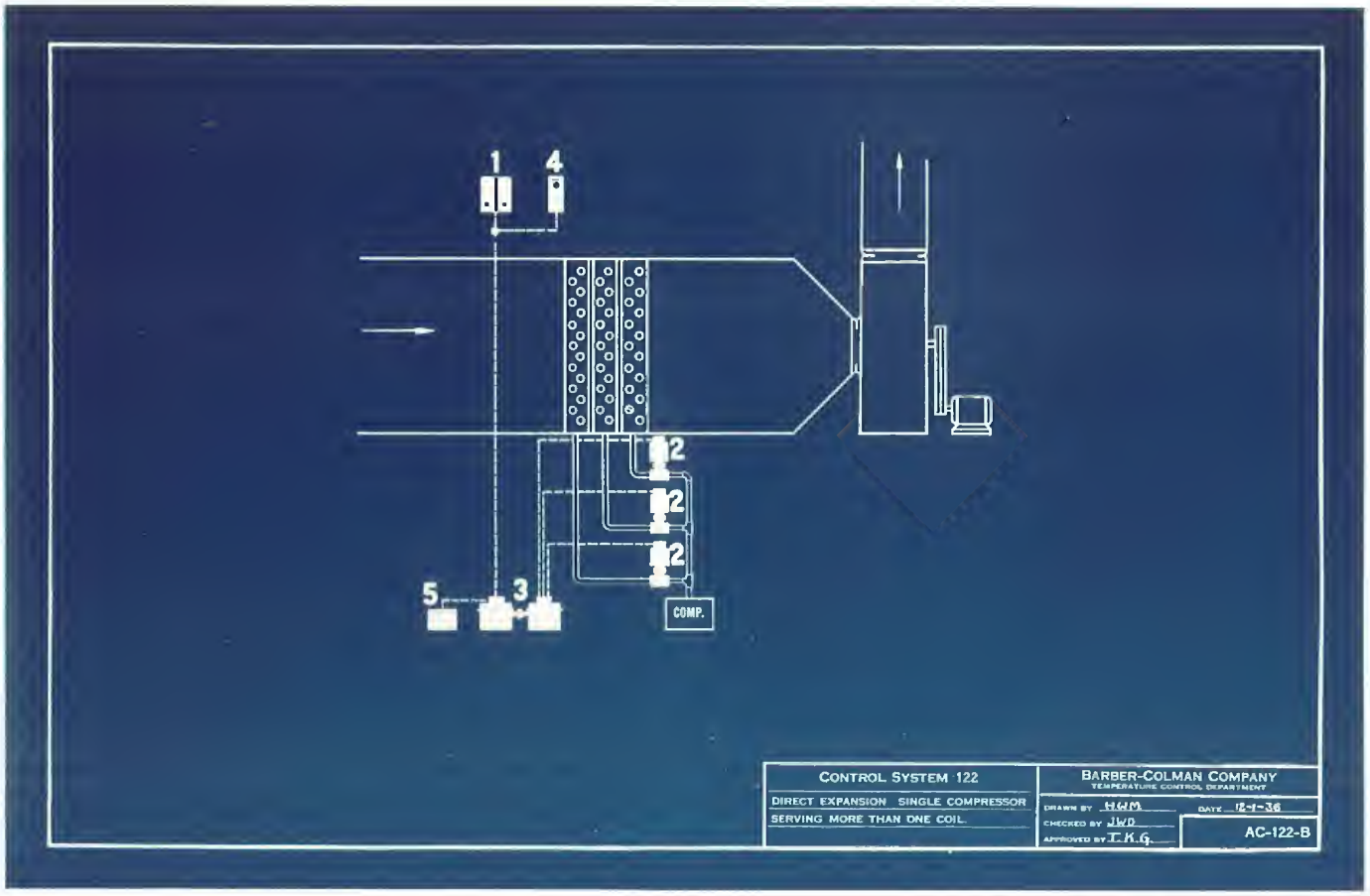
When the Manually Operated Switch (7) is set to "off" position, Program Switch (3) will be run to "off" position, stopping all compressors. When Switch (7) is set to "on" position, Program Switch (3) will be placed under control of Microtherm (1) and Hygrostat (6), and function as described above.

Time Switch (5) is controlled from an internal switch in Program Switch (3) in such a manner that its synchronous motor runs only when one or more compressors are in operation. In this way the reversal of sequence of operation of the compressors takes place after every 12 hours of actual operation, thus equalizing the wear on the compressors.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 122

Direct Expansion—Single Compressor Serving More Than One Coil.



The above layout illustrates the control of three Solenoid Valves in such a manner that the number of open Valves are increased or decreased automatically to meet requirements. Any number of Valves can be controlled in this manner.

Controls	Data Sheet
1. Microtherm	T-10
2. Solenoid Refrigerant Valve. One required for Each Coil	V-120
3. Holding Contact Program Switch with Microtrol Driving Unit	DC-10
4. Hygrostat	H-10
5. Single Pole, Double Throw Switch, sYZe 3 or 4	A-10

DESCRIPTION OF OPERATION

Temperature Control. Microtherm (1) controls the operation of Program Motor (3) which in turn opens one or more Solenoid Refrigerant Valves (2) to maintain the desired room temperature.

On demand for cooling, Microtherm (1) starts Program Switch (3), which in turn opens the first Valve. If the demand increases, the second and third Valves will open after pre-determined intervals. When Microtherm (1) is satisfied, Program Switch (3) stops, allowing the Valves that have been opened to remain open. On demand for less cooling, Program Switch (3) runs in the reverse direction to close one or more of the Valves or all of them if the demand continues.

Humidity Control. Hygrostat (4) also controls the operation of Program Motor (3) and is so wired that it has controlling preference over Microtherm (1) and will keep the Solenoid Valves open whenever, and as long as, necessary to maintain the desired humidity.

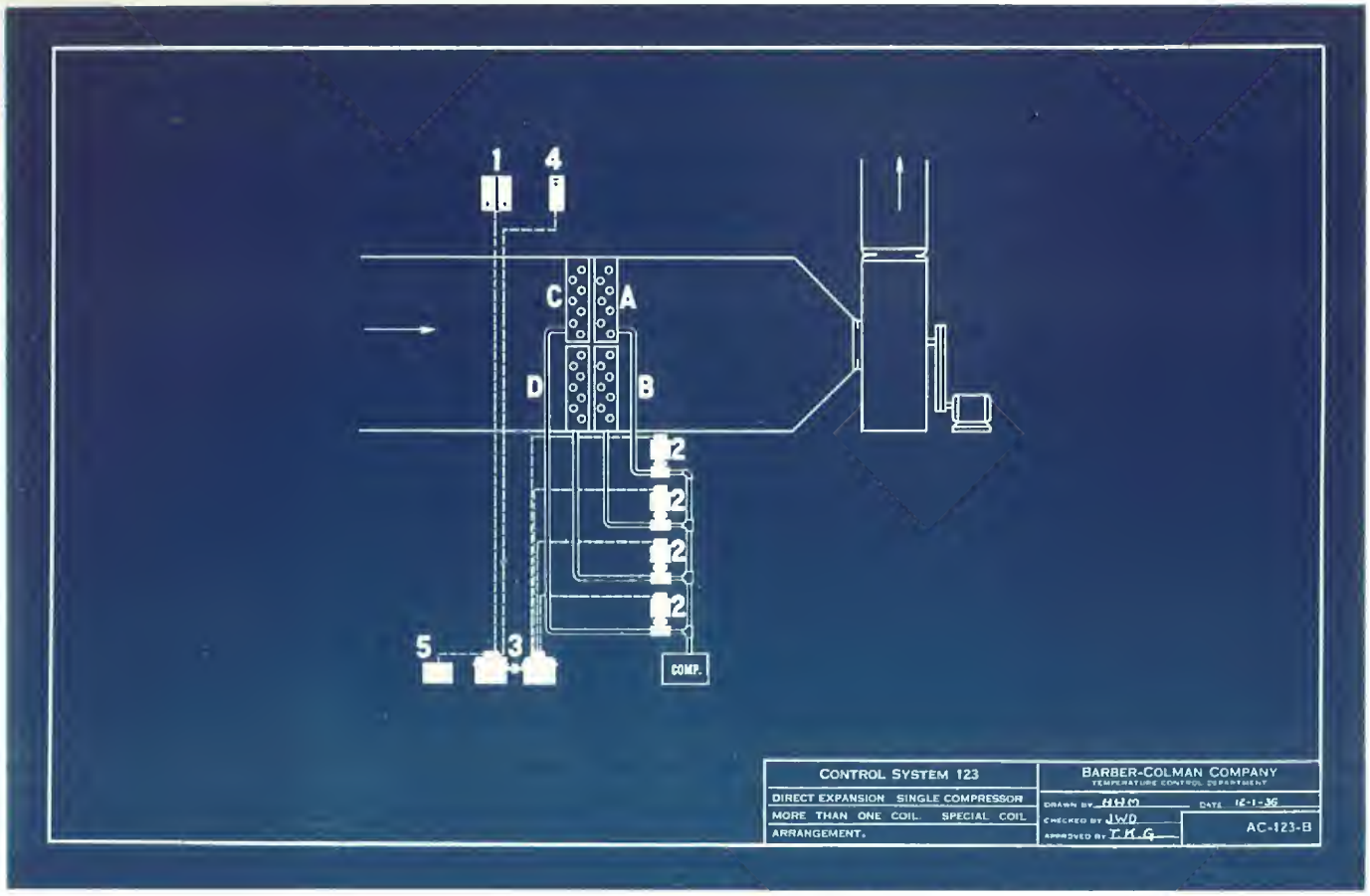
Solenoid Valve Control. Program Switch (3) is driven by a reversing motor which may be stopped in any position and restarted in either direction. In the "off" position all Solenoid Valves are closed. The motor drives a series of cam-operated switches so as to open or close the Valves in progressive sequence with predetermined minimum intervals. The speed of this motor is adjustable so as to permit the proper adaptation to individual installations. A Manually Operated Switch (5) is provided to shut off the Valves when desired.

In a system of this kind the compressor motor is usually controlled by a pressure switch on the refrigerant line.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 123

Direct Expansion—Single Compressor Serving More Than One Coil. Special Coil Arrangement for Humidity Control.



The above layout illustrates the control of 4 Solenoid Valves which regulate the refrigerant to 4 coils. The arrangement of coils permits removing maximum amount of sensible heat when required to lower room temperature, and maximum amount of latent heat with a minimum of sensible heat when required to reduce the humidity.

Controls	Data Sheet
1. Microtherm	T-10
2. Solenoid Refrigerant Valve. One required for each coil	V-120
3. Special Holding Contact Program Switch with Microtrol Driving Unit	DC-10
4. Hygrostat	H-10
5. Single Pole, Double Throw Switch, sYZe 3 or 4	A-10

DESCRIPTION OF OPERATION

Temperature Control. Microtherm (1) controls the operation of Program Motor (3) which in turn opens one or more Solenoid Refrigerant Valves (2) to maintain the desired room temperature.

On demand for cooling, Microtherm (1) starts Program Switch (3), which in turn opens the Valve to coil A. If the demand increases, the Valves to coils B, C, D will open after predetermined intervals. When Microtherm (1) is satisfied, Program Motor (3) stops, allowing the Valves that have been opened to remain open. On demand for less cooling, Program Switch (3) runs in the reverse direction to close one or more of the Valves or all of them if the demand continues.

When the demand requires only 2 coils for refrigeration, coils A and B are used, and as they cover the entire area of the duct, they permit the maximum amount of sensible cooling from any two coils.

Humidity Control. Hygrostat (4) also controls the operation of Program Switch (3) and may be wired so that it will operate Program Switch (3) only when Microtherm (1) is satisfied, or it may be wired so that it has controlling preference over Microtherm (1) and will keep the Solenoid Valves open whenever, and as long as, necessary to maintain the desired humidity.

On demand for less humidity, Program Switch (3) runs to a position that opens Valves to coils A and C, closing Valves to coils B and D. Under this condition, air passing through coils A and C is cooled to a low temperature, removing a large amount of moisture, while air passing through coils B and D is not cooled and is used for reheating, thus minimizing the total temperature drop of the air at the fan discharge.

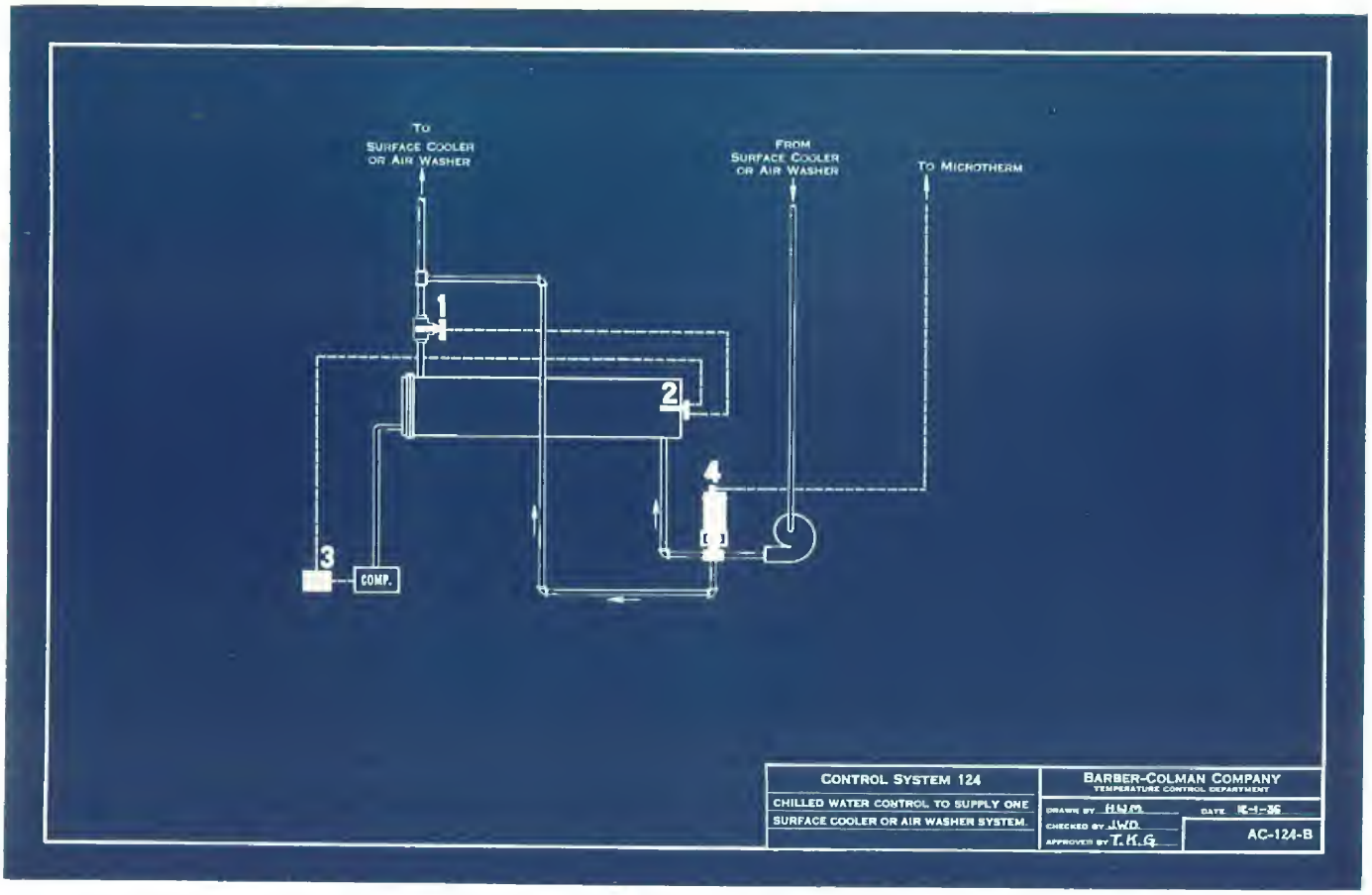
Solenoid Valve Control. Program Switch (3) is driven by a Reversing Motor which may be stopped in any position and restarted in either direction. In the "off" position, all Solenoid Valves are closed. The motor drives a series of cam-operated switches so as to open or close the Valves in the desired sequence with predetermined minimum intervals. The speed of this motor is adjustable so as to permit the proper adaptation to individual installations. A Manually Operated Switch (5) is provided to shut off the Valves when desired.

In a system of this kind the compressor motor is usually controlled by a pressure switch on the refrigerant line.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 124

Chilled Water Control to Supply One Surface Cooler or Air Washer System.



The above layout illustrates the control of the chilled water supply for one Air Conditioning System of either the Surface Cooler or Air Washer Type.

Controls	Data Sheet
1. Special Immersion Thermostat with extension between Case and Flange	T-10
2. Special Immersion Thermostat with Extension between Case and Flange	T-10
3. Single Pole, Single Throw Relay, cYZp 1-1	A-10
4. Three-way Valve, Microvalve Operator	V-100

DESCRIPTION OF OPERATION

Compressor Control. Thermostat (1) set at 45 F controls the operation of the compressor through Relay (3) to maintain a constant temperature of the chilled water leaving the cooler. On call for cooling, compressor starts and continues to run until Thermostat (1) is satisfied. Thermostat (2) set at 35 F is wired so that it will operate Relay (2) stopping the compressor if the temperature of the water in the cooler should drop to 35 F. This precaution is taken to guard against damage due to freezing if the pump stopped; in which case Thermostat (1) would not be effective because of its location in the circulating line from the cooler.

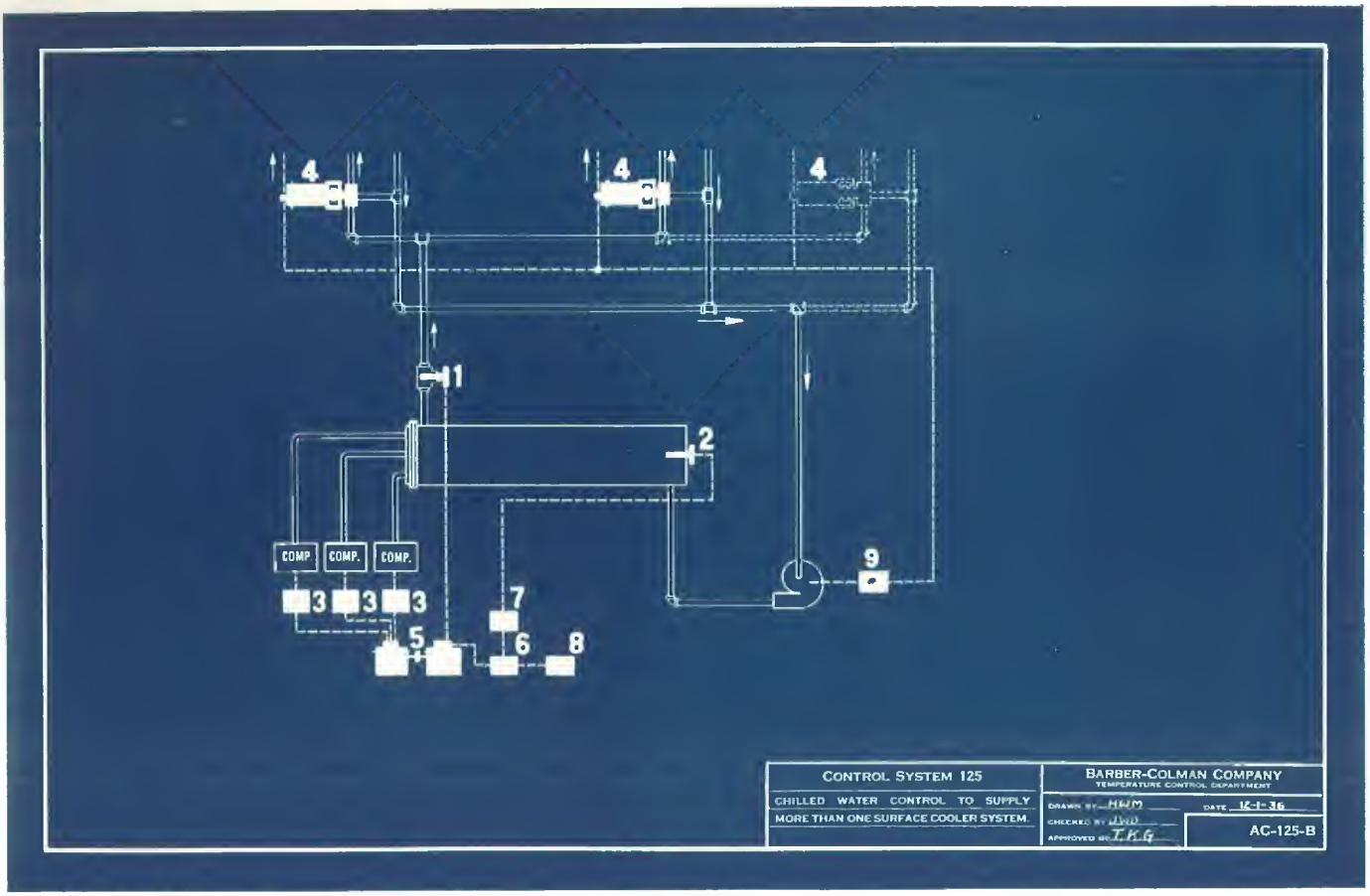
The motor starter furnished with the compressor motor must of course be used in addition to Relay (2).

Control of Surface Cooler or Air Washer. Three-way Valve (4) controlled by either a room or duct type Microtherm, regulates the proper proportion of chilled water and recirculated water to maintain the desired temperature. It operates in such a manner that on a continued call for heat the valve admits all recirculated water, and on a continued call for cooling it admits all chilled water. In intermediate positions accurate proportioning is obtained. The Valve Operator is of the throttling type, and may be stopped in any position (when demands for heating and cooling are satisfied) and restarted in either direction.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 125

Chilled Water Control to Supply More Than One Surface Cooler System.



The above layout illustrates the control of the chilled water supply when used with two or more Surface Cooler installations.

Controls	Data Sheet
1. Microtherm, Immersion Type	T-10
2. Special Immersion Thermostat with extension between Case and Flange	T-10
3. Single Pole, Single Throw Relay, cYZp 1-1. One required for each Compressor	A-10
4. Three-way Valve, Throttling Type. One required for each System	V-100
5. Selective Compressor Control Program Switch with Microtrol Driving Unit	DC-10
6. Special Relay. Three normally open, and one normally closed Contacts	A-10
7. Single Pole, Single Throw Switch, sYZe 1 or 2	A-10
8. Time Switch, 25 Volt Motor, bYZp 4	A-10
9. Single Pole, Single Throw Relay, cYZp 1-1	A-10

DESCRIPTION OF OPERATION

Compressor Control. Microtherm (1) set at 45 F, controls the operation of Program Switch (5) which in turn regulates the operation of the compressors to maintain a constant temperature of the chilled water leaving the cooler. The Microtherm is used because, in addition to accurately controlling the temperature of the water, it positions the Program Switch for every temperature requirement. "Hunting" is eliminated, and unnecessary starting and stopping of the compressors is thereby avoided. Thermostat (2) set at 35 F, is wired so that it will stop all compressors, should the temperature of the water in the cooler drop to 35 F. This precaution is taken to guard against damage due to freezing if the pump stopped; in which case Microtherm (1) would not be effective because of its location in the circulating line from the cooler.

Program Switch (5) is driven by a reversing motor which may be stopped in any position and restarted in either direction. In the "off" position all compressors are off. The motor drives a series of cam-operated switches, so as to start or stop the compressors in progressive sequence with predetermined intervals. The speed of this motor is adjustable, so as to permit the proper adaptation to individual installations. A Manually Operated Switch (7) is provided to shut off the compressors when desired.

CONTROL SYSTEM 125—Continued

On demand for cooling, Microtherm (1) starts Program Switch (5), which in turn starts the first compressor. If the demand increases, the second and third compressors will start after predetermined intervals. When Microtherm (1) is satisfied, Program Switch (5) stops, allowing the compressors that have been started to continue to run. On demand for less cooling, Program Motor (5) runs in the reverse direction to stop one or more of the compressors or all of them if the demand continues.

In the event of current failure, all compressors will be stopped. Upon resumption of current, Program Switch (5) will return to the "off" position before permitting the compressors to be started in their normal sequence.

When Manually Operated Switch (7) is set to the "off" position, Program Switch (5) will be run to the "off" position, stopping all compressors. When Switch (7) is set to the "on" position, Program Switch (5) will be placed under control of Microtherm (1) and operate the compressors automatically as described above. Time Switch (8) is controlled from an internal switch in Program Switch (5) in such a manner that its synchronous motor runs only when one or more compressors are in operation. In this way the reversal of sequence of operation of the compressors takes place after every 12 hours of actual operation, thus equalizing the wear on the compressors.

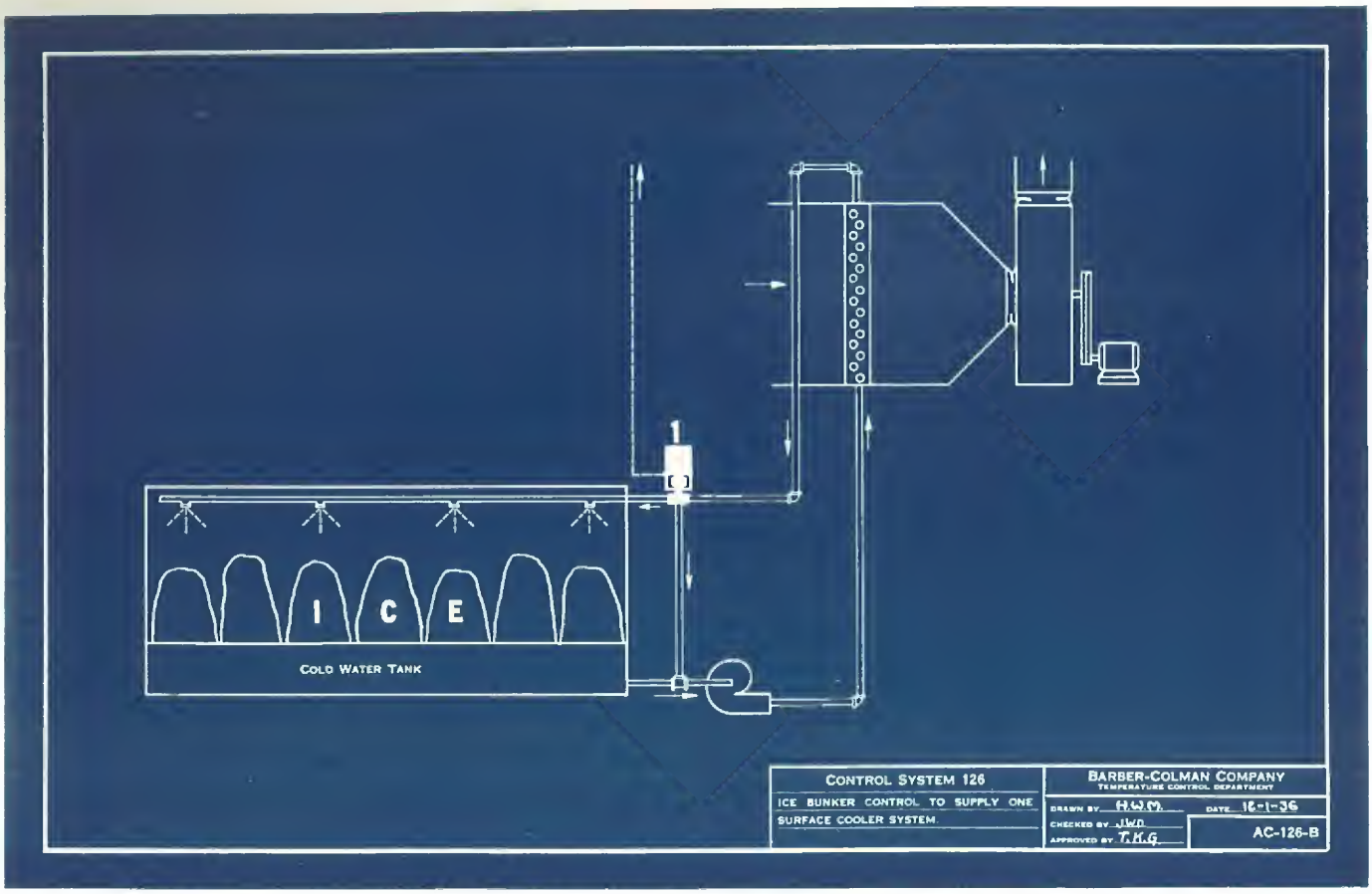
Control of Surface Coolers. Three-way Valves (4), controlled by either room or duct Thermostats, regulate the proper proportion of chilled water and recirculated water in their respective systems, to maintain the desired temperature. Each Valve is operated in such a manner that on a continued call for heat the Valve admits all recirculated water; and on a continued call for cooling the Valve admits all chilled water. In intermediate positions accurate proportioning is obtained. The Valve Operators are of the Throttling type, and may be stopped in any position (when demands for heating and cooling are satisfied) and restarted in either direction.

Control of Circulating Pump. Relay (9) stops the circulating pump motor when every one of the Three-way Valves (4) are admitting all recirculated water (no chilled water), indicating that no further cooling is required. Pump motor starts and will continue to run when any one of the Three-way Valves (4) opens to admit any chilled water.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 126

Ice Bunker Control to Supply One Surface Cooler System.



The above layout illustrates the control of an Ice Bunker supplying chilled water to a Surface Cooler System.

Controls	Data Sheet
1. Positive Three-way Valve	V-100

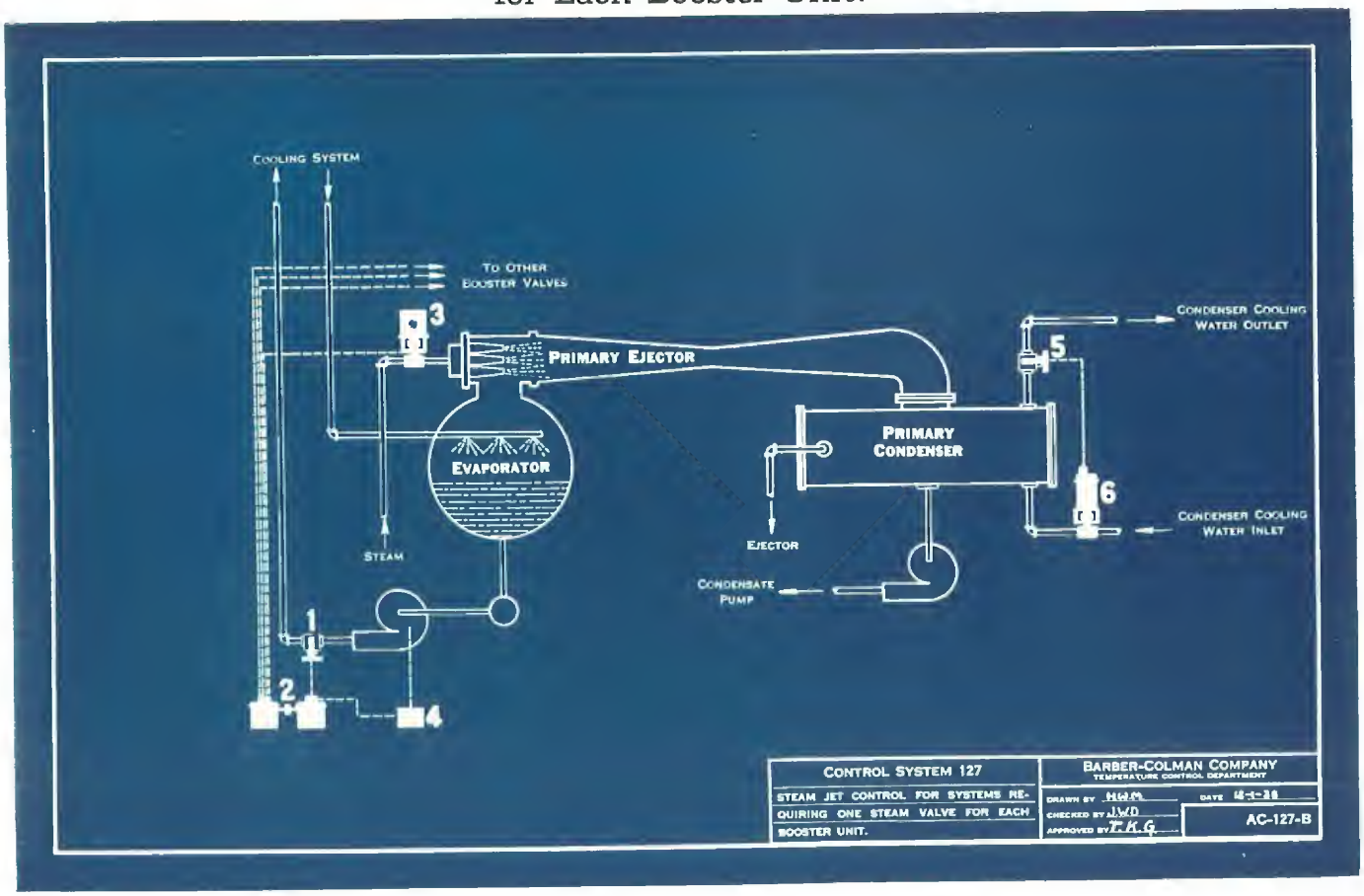
DESCRIPTION OF OPERATION

Three-way Valve (1), controlled by either a Room or Duct type Thermostat, permits either chilled water or recirculated water to be circulated through the cooling coils to maintain the desired temperature. It operates in such a manner that on a call for heat the Valve admits all recirculated water and on a call for cooling it admits all chilled water.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 127

Steam Jet Control for Systems Requiring One Steam Valve for Each Booster Unit.



The above layout illustrates the control of a Steam Jet System which requires only one Steam Valve for each Booster Unit.

Controls	Data Sheet
1. Microtherm, Immersion Type	T-10
2. Positive Valve Control Program Switch with Microtrol Driving Unit	DC-10
3. Positive Valve. One required for each Booster Unit	V-50
4. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
5. Insertion Thermostat, fYDj 155	T-10
6. Throttling Valve	V-80

DESCRIPTION OF OPERATION

Control of Water Temperature in Evaporator. Microtherm (1) set at 40 F, controls the operation of Program Motor (2) which in turn operates one or more Valves (3) to maintain a constant temperature of the chilled water leaving the evaporator. Relay (4), wired in parallel with the pump motor, will run Program Switch (2) to the "off" position, closing all Valves (3), whenever the pump motor stops. This will prevent any possibility of water freezing in the evaporator.

Control of Steam to Boosters. Program Switch (2) is driven by a reversing motor which may be stopped in any position and restarted in either direction. In the "off" position all Valves (3) are off. The motor drives a series of cam-operated switches so as to start or stop the Valves in progressive sequence with predetermined intervals. The speed of this motor is adjustable so as to permit the proper adaptation to individual installations.

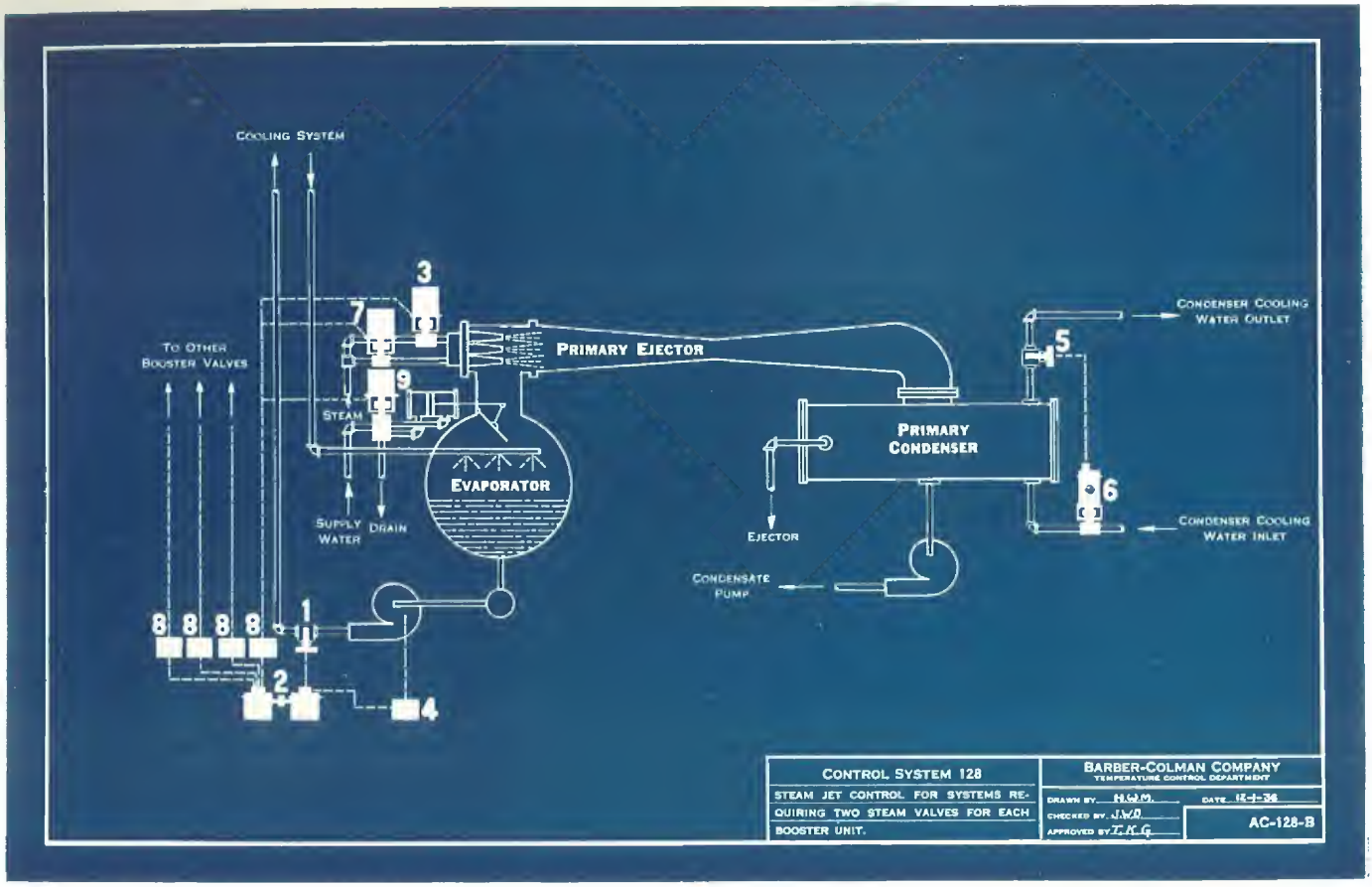
On demand for cooling, Microtherm (1) starts Program Switch (2), which in turn opens Valve (3) on the first Booster Unit. If the demand increases, Valves on the second and third Booster Units will open after predetermined intervals. When Microtherm (1) is satisfied, Program Switch (2) stops, allowing the Valves that have been opened to remain open. On demand for less cooling, Program Switch (2) runs in the reverse direction to close Valves on one or more of the Booster Units, or all of them if the demand continues.

Control of Water Temperature in Condenser. Thermostat (5) set at 95 F, controls the operation of Throttling Valve (6) to maintain a constant temperature of the water leaving the condenser.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 128

Steam Jet Control for Systems Requiring Two Steam Valves for Each Booster Unit.



The above layout illustrates the control of a Steam Jet System which requires two Steam Valves for each Booster Unit.

Controls	Data Sheet
1. Microtherm, Immersion Type	T-10
2. Positive Valve Control Program Switch with Microtrol Driving Unit	DC-10
3. Positive Valve. One required for each Booster Unit.	V-50
4. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31	A-10
5. Insertion Thermostat, fYDj 155	T-10
6. Throttling Valve	V-80
7. Positive Valve. One required for each Booster Unit	V-20 or V-50
8. Single Pole, Double Throw Relay, cYZp 4-1, 5-1 or 31. One required for each Booster Unit	A-10
9. Four-way Valve	

DESCRIPTION OF OPERATION

Control of Water Temperature in Evaporator. Microtherm (1) set at 40 F, maintains a constant temperature of the chilled water leaving the evaporator by controlling the operation of Program Switch (2) which in turn energizes one or more Relays (8) to put into operation the corresponding number of Booster Units. To prevent any possibility of freezing in the evaporator, Relay (4) is wired in parallel with the pump motor, so that when the pump stops, Program Switch (2) is run to the "off" position, thereby closing all Valves, and shutting down all Booster Units.

Control of Steam to Booster Units. Program Switch (2) is driven by a reversing motor which may be stopped in any position and restarted in either direction. The motor drives a series of cam-operated switches so as to energize or de-energize Relays (8) in progressive sequence with predetermined intervals. In the "off" position, all Relays (8) are de-energized. Each Relay (8) controls its corresponding Booster Unit in the following manner:

RELAY ENERGIZED
Starting Valve (7) opens.
Running Valve (3) opens.
Four-way Valve (9) positions to operate hydraulic cylinder to open valve in evaporator.
Starting Valve (7) closes.

RELAY DE-ENERGIZED
Four-way Valve (9) positions to operate hydraulic cylinder to close valve in evaporator.
Running Valve (3) closes.

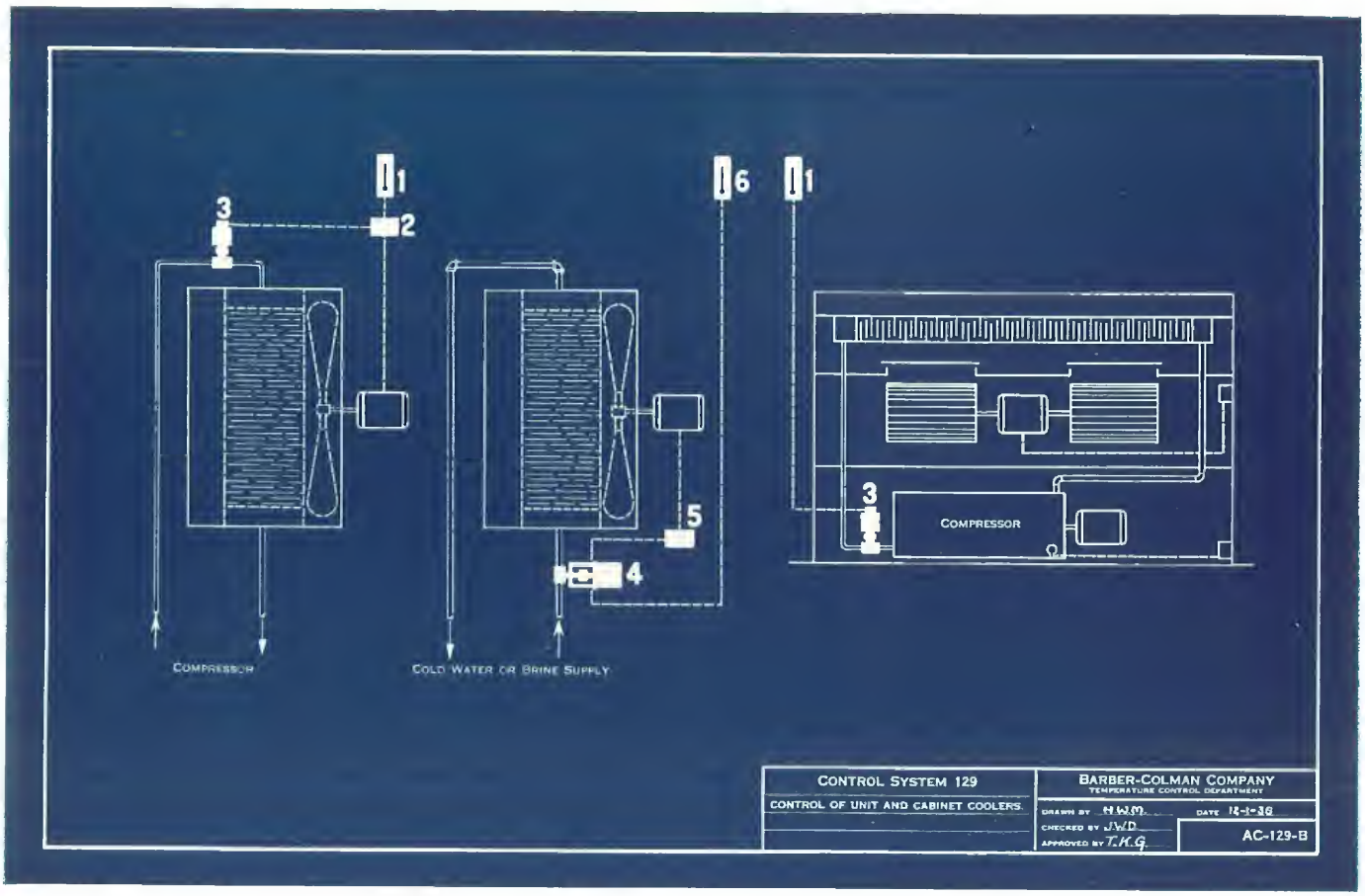
The above sequences are obtained by wiring through the auxiliary cam-operated switches in the Valve Operators, the operation of any Valve in the sequence being such that the Valve does not start to open (or close) until the preceding Valve in the sequence has completed its opening (or closing) stroke. In this way the necessary time delay is obtained between the successive operations.

Control of Water Temperature in Condenser. Thermostat (5) set at 95 F, controls the operation of Throttling Valve (6) to maintain a constant temperature of the water leaving the condenser.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 129

Control of Unit and Cabinet Coolers.



The above layouts illustrate the control of Unit Coolers.
Fig. 1, Direct Expansion. Fig. 2, Cold Water or Brine. Fig. 3, Cabinet type Room Cooler.

Controls	Data Sheet
1. Thermostat, YDa 286	T-10
2. Single Pole, Single Throw Relay, cYZp 27	A-10
3. Solenoid Valve	V-120
4. Positive Valve with Extension Bonnet	
5. Single Pole, Single Throw Relay, cYZp 1-1	A-10
6. Thermostat, YDa 291	T-10

DESCRIPTION OF OPERATION

Direct Expansion, Fig. 1. Thermostat (1) controls Relay (2) which in turn controls the operation of the fan motor and Solenoid Valve (3). On call for cooling, fan starts and Solenoid Valve opens, admitting the refrigerant to the coils. On call for less cooling, fan stops, and Solenoid Valve closes cutting off supply of refrigerant to coils.

If circulation of air is desired throughout the operating period, Thermostat (1) can be wired directly to Solenoid Valve (3), the fan motor then being controlled by a manually operated switch.

Cold Water or Brine. Fig. 2. Thermostat (6) controls operation of Positive Valve (4), which in turn, through cam-operated auxiliary switches, controls Relay (5) and the operation of the fan motor. On call for cooling, Valve (4) opens, admitting cold water or brine to the coils. As Valve opens, Relay is energized, starting the fan. On call for less cooling, Valve (4) closes, cutting off the supply of cold water or brine to the coils. As Valve closes, Relay is de-energized, stopping the fan motor. Automatic control of the cold water or brine supply, not shown, is described in Control Systems 124 and 125.

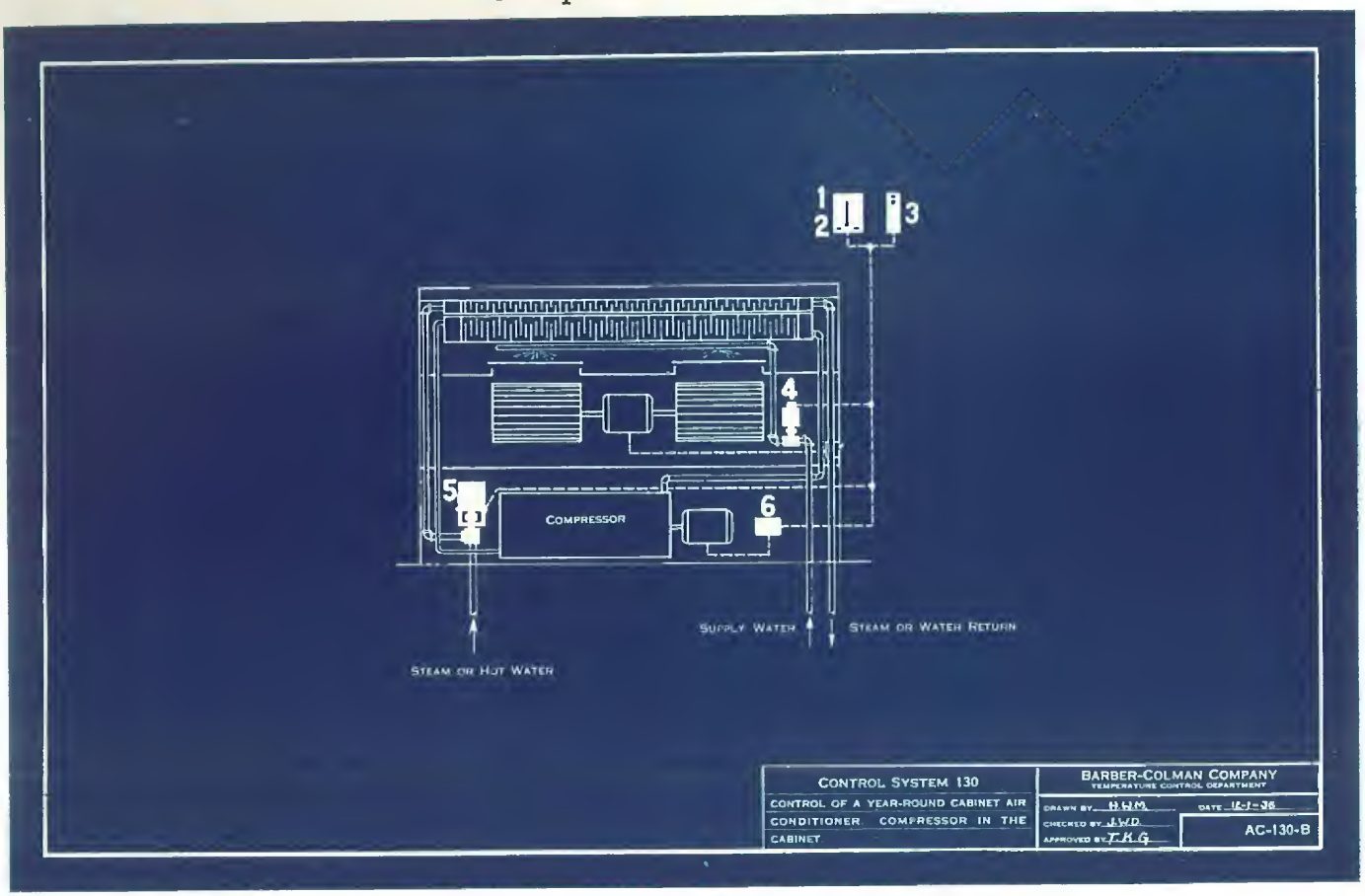
Cabinet Type Room Cooler. Fig. 3. Thermostat (1) operates Solenoid Valve (3) to control the refrigerant to the coils and maintain the desired room temperature. With this type of unit the fan is usually manually controlled to permit air circulation. However, if desired, the fan may be cut off when the Solenoid Valve closes and automatically started when Valve opens. During operating periods the compressor is usually automatically controlled from a pressure switch. During off periods it may be cut off either manually or automatically by a time switch.

A number of cooling units may be operated from a single compressor, remotely installed, by controlling as described in Fig. 1.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 130

Control of a Year-Round Cabinet Air Conditioner. Compressor in Cabinet.



The above layout illustrates the control of a typical Cabinet type Air Conditioner in which the compressor is mounted in the cabinet.

Controls	Data Sheet
1. and **2.** Combined as Summer-Winter Duplex Thermostat, cYDb 270	T-10
3. Hygrostat	H-10
4. Solenoid Water Valve	V-120
5. Positive Valve	V-10 or V-20
6. Single Pole, Single Throw Relay, cYZp 1-1	A-10

DESCRIPTION OF OPERATION

Cooling Cycle. Thermostat (1) controls the operation of the compressor. On call for cooling, the compressor starts and continues to run until Thermostat is satisfied.

Heating Cycle. Thermostat (2) controls the operation of Positive Valve (5). On call for heat, Valve opens; on call for cooling, Valve closes.

Fan Control. The fan may be wired so that it will run whenever either the compressor is running or Valve (5) is open. A manually operated switch may be provided to permit the fan to be run continuously whenever air circulation is desired.

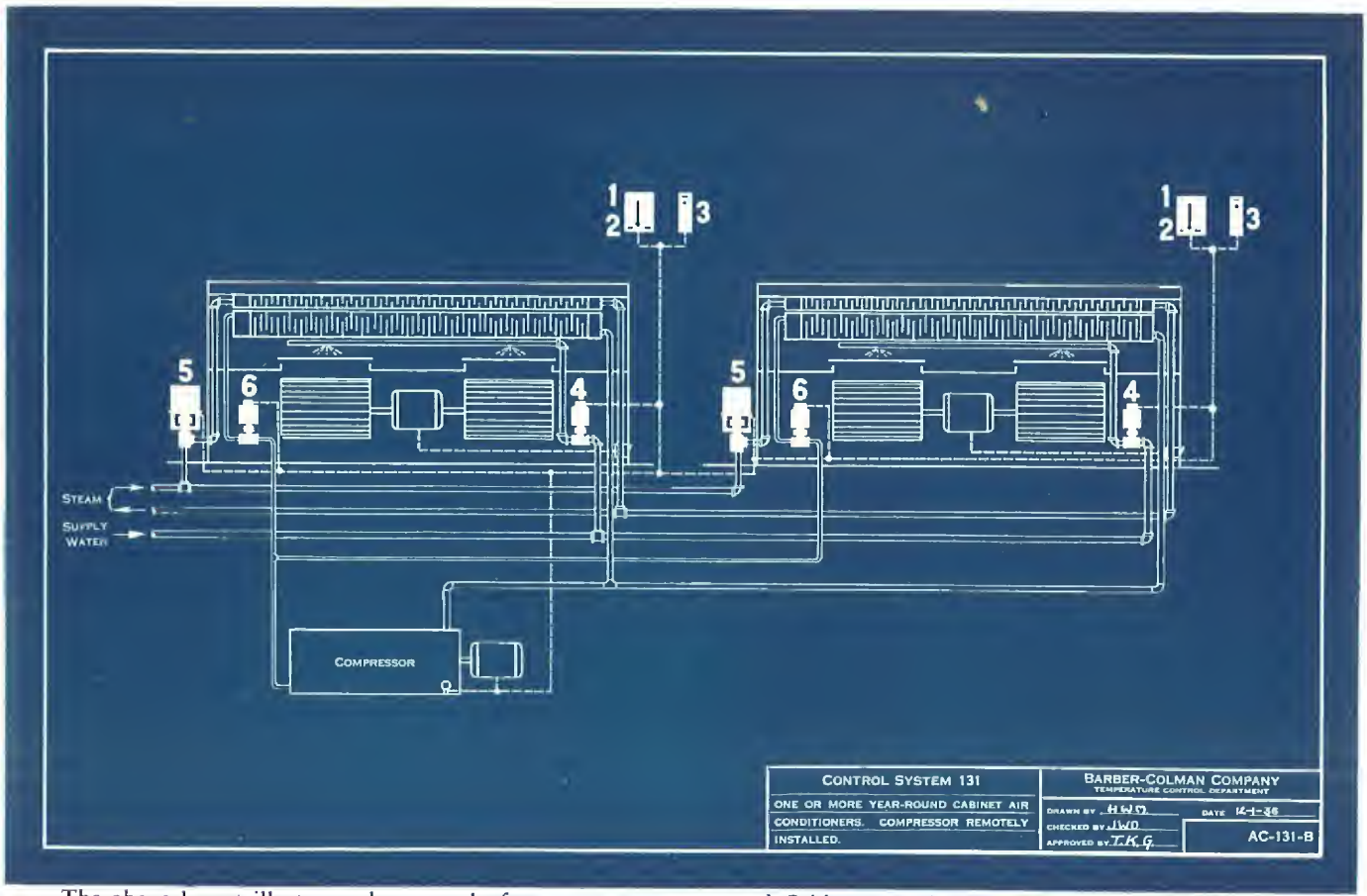
Humidity Control. *Heating Cycle.* Hygrostat (3) controls the operation of Solenoid Valve (4) to add moisture and maintain the desired relative humidity.

If desired, Thermostats (1) and (2) may be furnished with their adjusting levers mechanically connected so as to prevent any possibility of Valve (5) being open when the compressor is running, and vice versa.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 131

Control of Two or More Year-Round Cabinet Air Conditioners. Compressor Remotely Installed.



The above layout illustrates the control of two or more year-round Cabinet type Air Conditioners operated from one compressor remotely installed.

Controls	Data Sheet
1. and **2.** Combined as Summer-Winter Duplex Thermostat, cYDb 270. One required for each Unit	T-10
3. Hygrostat	H-10
4. Solenoid Water Valve. One required for each Unit	V-120
5. Positive Valve. One required for each Unit	V-10 or V-20
6. Solenoid Refrigerant Valve. One required for each Unit	V-120

DESCRIPTION OF OPERATION

Cooling Cycle. Thermostat (1) controls the operation of Solenoid Valve (6) to admit the refrigerant to the cooling coils to maintain the desired temperature. On call for cooling, Valve opens; on call for less cooling, Valves closes.

During operating periods the compressor is usually automatically controlled from a pressure switch. During off periods it may be cut off either manually or automatically by a time switch. If a number of units are to be operated, it may be found more economically to have more than one compressor. In this way one compressor would carry the normal load and another compressor would cut in automatically to take care of peak loads and to permit more rapid cooling after shutdown periods.

Heating Cycle. Thermostat (2) controls the operation of Positive Valve (5). On call for heat, Valve opens; on call for cooling, Valve closes.

Fan Control. The fan may be wired so that it will run whenever either the compressor is running or any one of Valves (5) are open. A manually operated switch may be provided to permit the fan to be run continuously whenever air circulation is desired.

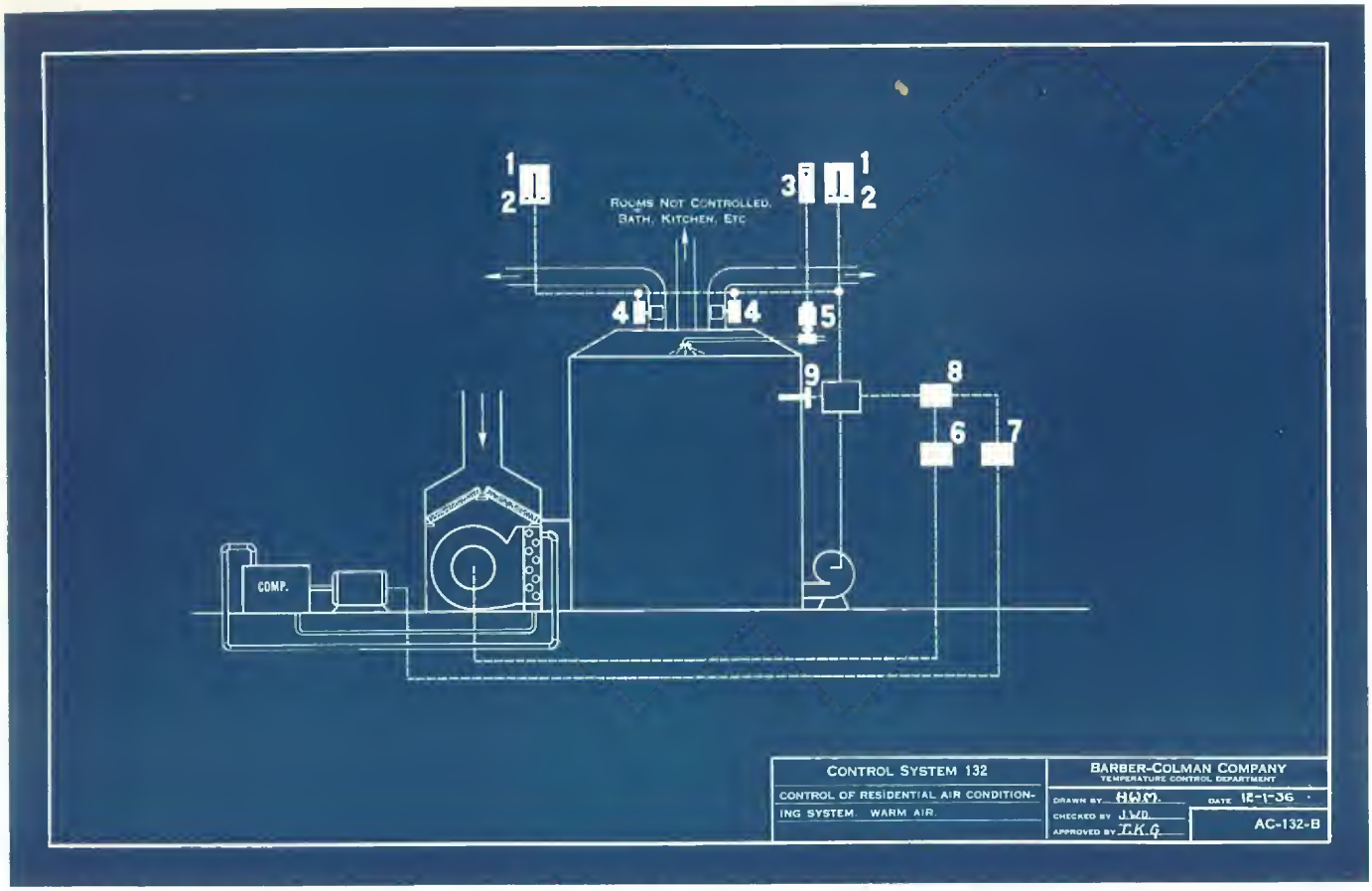
Humidity Control. Hygrostat (3) controls the operation of Solenoid Valve (4) to add moisture and maintain the desired relative humidity.

If desired, Thermostats (1) and (2) may be furnished with their adjusting levers mechanically connected so as to prevent any possibility of Valve (5) being open when the compressor is running, and vice versa.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 132

Control of a Residential Air Conditioning System. Warm Air.



The above layout illustrates the control of a typical residential Air Conditioning System of the forced air type. Zone or individual room control permits different temperatures to be maintained in different parts of the house. Shift from Summer to Winter operation is made by manually operated switches.

Controls	Data Sheet
1. and **2.** Combined as Summer-Winter Duplex Thermostat, cYDb 270. One required for each zone or room to be controlled	T-10
3. Hygrostat	H-10
4. Positive Damper Control Motor, Group DC-200 or 300. One required for each zone or room to be controlled	DC-10
5. Solenoid Water Valve	V-120
6. Single Pole, Single Throw Relay, cYZp 1-1	A-10
7. Single Pole, Single Throw Relay, cYZp 1-1	A-10
8. Switch Panel. Number of switches depending upon the number of zones or rooms to be controlled	A-10
9. Furnace Thermostat, fYDj 152	T-10

DESCRIPTION OF OPERATION

Switches in Panel (8) are placed in the Summer position for operation of the system during the cooling cycle, and in the Winter position during the heating cycle.

Room Control, *Cooling Cycle.* Each Summer Thermostat (1) controls its respective positive Damper Control Motor (4) which in turn operates the shut-off damper to the zone or room. These dampers operate so that they are always in either the full open or closed position. In the closed position the dampers will still admit air equal to about one-third of that admitted in the open position, or that amount required for ventilation. On call for cooling, dampers open; on call for heat, dampers close.

Heating Cycle. Each Winter Thermostat (2) controls its respective Positive Damper Control Motor (4) in the same manner as during the cooling cycle, only in the reverse order; i.e., on call for heat, dampers open; on call for cooling, dampers close.

As an improvement, especially on large installations with a greater number of zones, a static pressure regulator may be installed.

CONTROL SYSTEM 132—Continued

Compensated Control will improve the operation, and permit the best possible temperature regulation during the heating cycle. This is accomplished by using Heater type Thermostats, in place of cYDb 270 as shown, and the addition of Varitherms, rYDj 282. The latter, one for each zone, are installed between the damper and the room outlet. The operation of Compensated Control is described in detail in other literature.

Refrigeration Control. *Heating Cycle.* The compressor is cut out and cannot operate.

Cooling Cycle. The compressor is controlled through Relay (7) from the auxiliary switches in Damper Control Motors (4) in such a manner that it will operate whenever, and as long as, any one or more dampers are open. When all dampers are in the closed position the compressor will stop.

Fan Control. *Cooling Cycle.* Fan runs only when the compressor is running. However, a fan switch in Panel (8) is provided so that the fan may be made to operate continuously to provide air circulation.

Heating Cycle. The fan is controlled through Relay (6), from Thermostat (9) in the bonnet, in such a manner that it runs only when the temperature is above the setting of the Thermostat. In this way cold drafts are avoided.

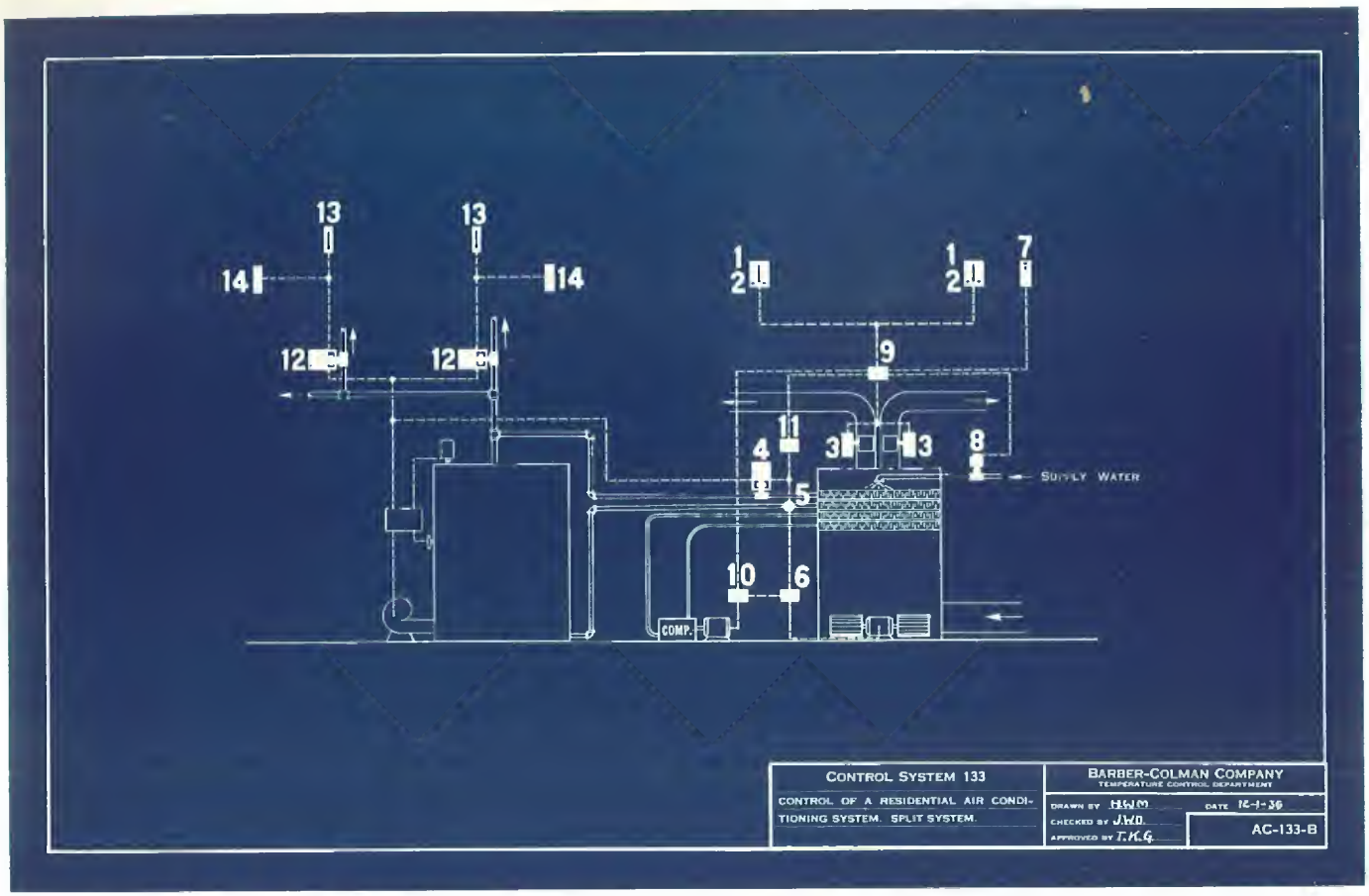
Humidity Control. *Heating Cycle.* Hygrostat (3) controls the operation of Solenoid Valve (5) to add moisture and maintain the desired relative humidity.

Furnace Control. *Heating Cycle.* The controls of the Air Conditioning System are connected to the oil burner, gas burner, or stoker control in such a manner that the burner will operate whenever any one of Damper Control Motors (4) are in the open position.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 133

Control of a Residential Air Conditioning System. Split System.



The above layout illustrates the control of a typical residential year-round Air Conditioning System in which some rooms are heated by direct radiation. Zone control is provided for both the direct and indirect parts of the system. Shift from Summer to Winter operation is made by a single manually operated switch.

Controls	Data Sheet
1 and **2.** Combined as Summer-Winter Duplex Thermostat, cYDb 270. One required for each zone or room	T-10
3. Positive Damper Control Motor, Group DC-200 or 300. One required for each zone or room	DC-10
4. Positive Valve	V-10 or V-20
5. Surface Thermostat, aYDp 192	T-10
6. Single Pole, Single Throw Relay, cYZp 1-1	A-10
7. Hygrostat	H-10
8. Solenoid Water Valve	V-120
9. Switch Panel. 1 Single Pole, Single Throw Fan Switch and 1 Double Pole, Double Throw Summer-Winter Switch	A-10
10. Single Pole, Single Throw Relay, cYZp 1-1	A-10
11. Single Pole, Double Throw Relay, cYZp 3-1	A-10
12. Positive Valve. One required for each zone of Direct Radiation	V-10 or V-20
13. Room Thermostat, YDa 302. One required for each zone of Direct Radiation	T-10
14. Varitherm, sYDp 277. One required for each zone of Direct Radiation	T-10

DESCRIPTION OF OPERATION

Summer-Winter Switch in Panel (9) is placed in the Summer position for operation of the system during the Cooling Cycle, and in the Winter position for operation during the Heating Cycle.

Zone or Room Control. *Control of Indirect Part of System. Cooling Cycle.* Each Thermostat (1) controls its respective Positive Damper Control Motor (3) which in turn operates the shut-off damper to the zone or room. These dampers operate so that they are always in either the full open or closed position. In the closed position the dampers will still admit air equal to about one-third of that admitted in the full open position, or that amount required for ventilation. On call for cooling, dampers open; on call for heat, dampers close.

CONTROL SYSTEM 133—Continued

When all dampers are closed the compressor will stop; any one damper opening will cause the compressor to start and continue running as long as one or more dampers are open.

Heating Cycle. Each Thermostat (2) controls its respective Positive Damper Control Motor (3) in the same manner as Thermostats (1) only in the reverse order; i.e., on call for heat, dampers open; on call for cooling, dampers close.

As an improvement, especially on large installations with a greater number of zones, a static pressure regulator may be installed.

Compensated Control will improve the operation, and permit the best possible temperature regulation during the heating cycle. This is accomplished by using Heater type Thermostats, in place of cYDb 270 as shown, and the addition of Varitherms, rYDj 282. The latter, one for each zone, are installed between the damper and the room outlet. The operation of Compensated Control is described in detail in other literature.

Control of Direct Radiation. Each Thermostat (13) controls its respective Positive Valve (12). On call for heat Valve opens; on call for cooling Valve closes. When all Valves (12) and Valve (4) are closed burner will stop; any one Valve opening will cause burner to start and continue running as long as one or more Valves are open.

Compensated Control. Each Room Thermostat (13) operates in conjunction with a Varitherm (14) installed on the last radiator in each zone. This combination permits very accurate control. Other literature is available which describes in detail the operation of the Compensated Control System.

Control of Heating Coil. *Cooling Cycle.* Valve (4) is run to the closed position and remains closed.

Heating Cycle. Valve (4) is controlled from the auxiliary switches in Damper Control Motors (3) in such a manner that it will open and remain open whenever, and as long as, any one or more Dampers are open. When all Dampers are in the closed position, Valve (4) will close.

Refrigeration Control. *Heating Cycle.* The compressor is cut out and cannot operate.

Cooling Cycle. The compressor is controlled through Relay (10) from the auxiliary switches in Damper Control Motors (3) in such a manner that it will operate whenever, and as long as, any one or more dampers are open. When all dampers are in the closed position, the compressor will stop.

Fan Control. *Cooling Cycle.* Fan runs only when the compressor is running. However, a fan switch in Panel (9) is provided so that the fan may be made to operate continuously to provide air circulation.

Heating Cycle. The fan is controlled by Thermostat (5) in such a manner that it runs only when the temperature in the return line from the heating coils is above the setting of the Thermostat. In this way cold drafts are avoided.

Humidity Control. *Heating Cycle.* Hygrostat (7) controls the operation of Solenoid Valve (8) to add moisture and maintain the desired relative humidity.

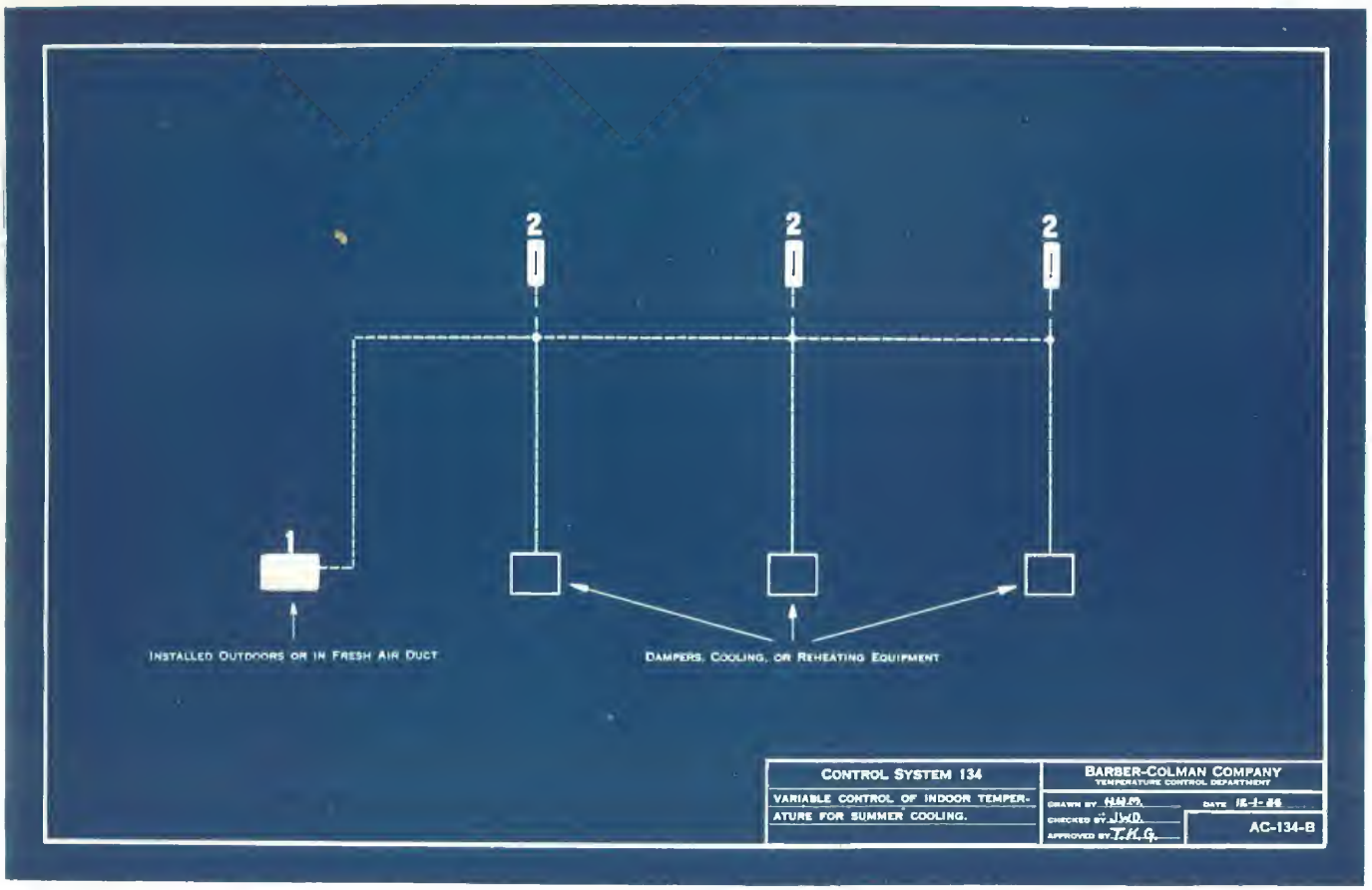
Cooling Cycle. Solenoid Valve (8) is closed and cannot operate. If desired, Hygrostat may be reset at a higher relative humidity and wired so that it controls the operation of the compressor; this will keep the compressor running whenever necessary to reduce the relative humidity.

Boiler Control. The controls of the Air Conditioning System are connected to the standard oil burner, gas burner, or stoker control in such a manner that the burner will operate whenever Valve (4), or any of the Valves (12), are open. Hot water for domestic use is provided through an indirect heater by maintaining the water in the boiler at a suitable temperature both Summer and Winter. The control of hot water is described in detail in other literature.

A reprint of this System, including wiring diagram, may be obtained upon request.

CONTROL SYSTEM 134

Variable Control of Indoor Temperature for Summer Cooling.



The above illustrates the use of the BARCOL Thermostatic Adjuster by means of which the control point in each of three rooms or zones is shifted automatically in accordance with outdoor temperature changes.

Controls	Data Sheet
1. Thermostatic Adjuster, Potentiometer Type, aYDs 117. One Thermostatic Adjuster will control a maximum of eight Control Point Thermostats.	T-10
2. Control Point Thermostat, YDa 249. One required for each room or zone to be controlled.	T-10

DESCRIPTION OF OPERATION

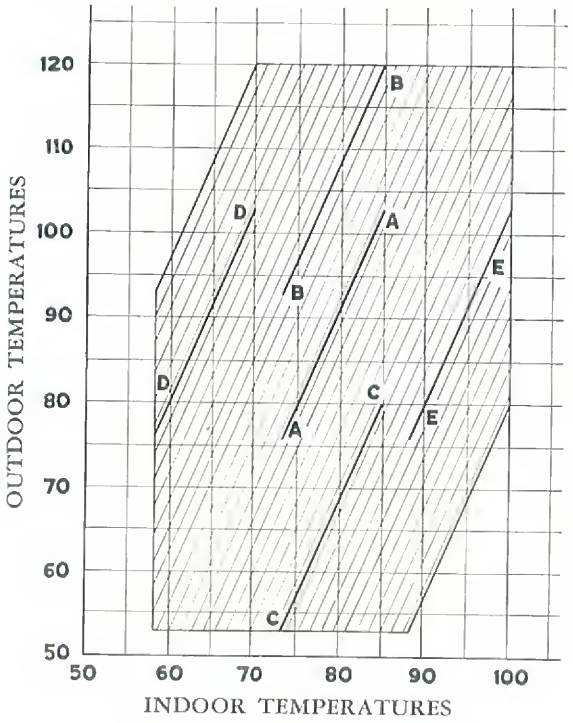
Each Control Point Thermostat (2) has a small heating element adjacent to the sensitive bimetal element, but electrically independent of the control circuit.

Thermostatic Adjuster (1) is constructed in such a manner that as the outdoor temperature changes, a reversible motor shifts the contact points and also positions a potential dividing rheostat. The potential dividing rheostat varies the amount of current to the heater elements in each of the Thermostats (2), so that the effectiveness of the heaters, in creating false temperatures within the Thermostat cases, will vary inversely with the outdoor temperatures; therefore, the control point of the Room Thermostats is raised or lowered in accordance with outdoor temperatures.

There is such a large number of different positions on the rheostat that the shift in the control point of the Room Thermostats is very gradual. The indoor temperatures maintained with this control are substantially the same as those suggested by the A.S.H.V.E. as being the most desirable for corresponding outdoor temperatures.

Line A-A in the chart on the following page shows the indoor temperatures maintained when the Thermostatic Adjuster is set at 100 F and the Room Thermostat is set at 85 F, the mid-point on the scale.

CONTROL SYSTEM 134—Continued



The Thermostatic Adjuster has a range of 27 degrees, and an adjusting lever permits this range to be shifted; lines B-B and C-C show the corresponding high and low limits. The adjusting lever always indicates the high limit of the operating range.

The 12 degree operating range of the Room Thermostats may also be shifted and lines D-D and E-E show the corresponding high and low limits. The adjusting lever indicates the high limit of the operating range.

Therefore, with this system, it is possible to maintain a temperature differential that may be represented by any line within the entire shaded area; the line, of course, to be of the same length and parallel to those shown.

It is possible also to maintain different temperatures in each zone or room where Thermostats are installed; these possibilities being represented by lines of the same length and parallel to those shown, but only those lines which would be horizontally opposite the line which is determined by a given setting of the Thermostatic Adjuster; e.g., if the Thermostatic Adjuster is set at 100 F, the room temperatures which may be maintained in the different rooms are represented by any line between D-D and E-E.

A reprint of this System, including wiring diagram, may be obtained upon request.

Miscellaneous Items Used in Installation of Temperature and Humidity Control Systems

POWER BOXES

Item	Capacity VA	Primary Voltage	Frequency Cycles	Overload Breaker	Overload Breaker Element
YBa 270-1	50	115	60	aYZp 2-1	aYZp 4-1
YBa 273-1	50	230	60	aYZp 2-1	aYZp 3-1
YBa 3527-1	50	440	60	aYZp 17-1	aYZp 13-1
YBa 3582-1	50	550	60	aYZp 17-1	aYZp 13-1
*YBa 4267-1	50	115	50	aYZp 2-1	aYZp 4-1
*YBa 4340-1	50	230	50	aYZp 2-1	aYZp 3-1
*YBa 4311-1	50	440	50	aYZp 17-1	aYZp 13-1
*YBa 4312-1	50	550	50	aYZp 17-1	aYZp 13-1
YBa 280-1	50	115	25	aYZp 2-1	aYZp 4-1
YBa 281-1	50	230	25	aYZp 2-1	aYZp 3-1
YBa 4135-1	50	440	25	aYZp 17-1	aYZp 13-1
YBa 4136-1	50	550	25	aYZp 17-1	aYZp 13-1
YBa 276-1	100	115	60	aYZp 2-1	aYZp 6-1
YBa 277-1	100	230	60	aYZp 2-1	aYZp 3-1
YBa 2993-1	100	440	60	aYZp 17-1	aYZp 13-1
YBa 4290-1	100	550	60	aYZp 17-1	aYZp 13-1
*YBa 3451-1	100	115	50	aYZp 2-1	aYZp 6-1
*YBa 4126-1	100	230	50	aYZp 2-1	aYZp 3-1
*YBa 4313-1	100	440	50	aYZp 17-1	aYZp 13-1
*YBa 4314-1	100	550	50	aYZp 17-1	aYZp 13-1
YBa 282-1	100	115	25	aYZp 2-1	aYZp 6-1
YBa 283-1	100	230	25	aYZp 2-1	aYZp 3-1
YBa 3341-1	100	440	25	aYZp 17-1	aYZp 13-1
YBa 4291-1	100	550	25	aYZp 17-1	aYZp 13-1
YBa 284-1	150	115	60	aYZp 2-1	aYZp 10-1
YBa 285-1	150	230	60	aYZp 2-1	aYZp 6-1
*YBa 4229-1	150	115	50	aYZp 2-1	aYZp 10-1
*YBa 4293-1	150	230	50	aYZp 2-1	aYZp 6-1
YBa 286-1	150	115	25	aYZp 2-1	aYZp 10-1
YBa 287-1	150	230	25	aYZp 2-1	aYZp 6-1
YBa 272-1	250	115	60	aYZp 2-1	aYZp 12-1
YBa 275-1	250	230	60	aYZp 2-1	aYZp 8-1
*YBa 4294-1	250	115	50	aYZp 2-1	aYZp 12-1
*YBa 4106-1	250	230	50	aYZp 2-1	aYZp 8-1
YBa 288-1	250	115	25	aYZp 2-1	aYZp 12-1
YBa 289-1	250	230	25	aYZp 2-1	aYZp 8-1

*The transformer in this power box has reduced secondary voltage so that it can be used with a standard 22½ volt, 60 cycle Valve Operator or Damper Control Motor.

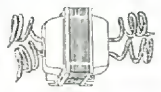
Extra for flush type steel cabinets. See Price List.

Note: Specify whether surface type or flush type is desired on order.

WIRE

Item	Type	Size	Covering
dYZp 1	Enameled Single-Conductor	16	Asbestos and Cotton
dYZp 2	Enameled Two-Conductor	16	Asbestos and Cotton, coded
dYZp 3	Enameled Two-Conductor	18	Asbestos and Cotton, coded
dYZp 4	Enameled Three-Conductor	18	Asbestos and Cotton, coded
dYZp 13	Enameled Four-Conductor	18	Asbestos and Cotton, coded
dYZp 5	Single-Conductor	16	Rubber and Cotton
dYZp 15	Two-Conductor	18	Rubber and Cotton, coded
dYZp 12	Three-Conductor	18	Rubber and Cotton, coded
dYZp 16	Five-Conductor	18	Rubber and Cotton, coded

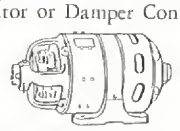
TRANSFORMERS



Item	Capacity VA	Primary Voltage	Secondary Voltage	Frequency, Cycles
bYZp 15	50	115	22½	60
bYZp 16	50	230	22½	60
*bYZp 41	50	115	20	50
*bYZp 42	50	230	20	50
bYZp 17	50	115	22½	25
bYZp 18	50	230	22½	25
bYZp 19-1	50	440	22½	60
bYZp 20-1	50	550	22½	60
bYZp 21	100	115	22½	60
bYZp 22	100	230	22½	60
*bYZp 43	100	115	20	50
*bYZp 44	100	230	20	50
bYZp 23	100	115	22½	25
bYZp 24	100	230	22½	25

*This transformer has reduced secondary voltage so that it can be used with a standard 22½ volt, 60 cycle Valve Operator or Damper Control Motor.

CONVERTERS



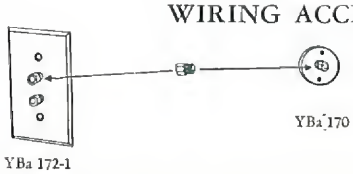
Item	Capacity VA	Primary DC Voltage	Secondary AC Voltage	Secondary AC Frequency
bYZp 6	50	115 or 230	x22½ or 115	60
bYZp 7	75	115 or 230	x22½ or 115	60
bYZp 8	100	115 or 230	x22½ or 115	60
bYZp 9	175	115 or 230	x22½ or 115	60
bYZp 10	300	115 or 230	115	60
bYZp 11	400	115 or 230	115	60
†bYZp 12	750	115 or 230	115	60
†bYZp 13	1000	115 or 230	115	60
†bYZp 14	1500	115 or 230	115	60

† Furnished with hand-operated starting box.
x Extra charge for 22½ volt secondary. See Price List.

SPECIAL TOOLS

Item	Description
YBa 222	Tubing Bender
YBa 262	Yoke Screw Wrench
YBa 263	Yoke Nut Socket Wrench
YBa 264-1	Tube Bushing Wrench
YDa 41-2	Lock Cover Key for Valves and Thermostats

WIRING ACCESSORIES



YBa 172-1 YBa 170 YBa 233-1

Item	Description
YBa 170	Wall plate assembly for tubing, single (Round)
YBa 171	Wall plate assembly for tubing, double (Round)
YBa 172-1	Flush plate assembly for tubing, double (Rectangular)
YBa 173-1	Flush plate assembly for tubing, single (Rectangular)
YBa 233-1	Flush plate assembly for tubing, single or double
YBa 100-1	Split bushing
YBa 252-2	Tubing clip, spring brass
eYZp 5	No. 1 Staple, Blake, insulated
eYZp 6	No. 3 Staple, Blake, insulated
eYZp 8	9/32" Aluminum tubing. 50 feet per lb.

Barber-Colman Company
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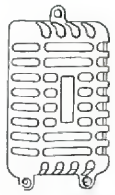
Miscellaneous Items Used in Installation of Temperature and Humidity Control Systems

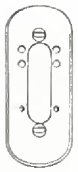
THERMOSTAT GUARDS



Cast metal, black crinkle finish, to protect Thermostats and prevent tampering. Perforated for maximum air circulation.

Item	For
YDa 46-2	Room or Compound Thermostat
cYDb 21-1	Two-Temperature or Duplex Thermostat
bYDt 90	Microtherm
fYDh 9	Hygrostat

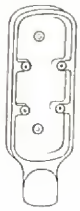
THERMOSTAT MOUNTING PLATES



For attachment to standard switch box.

Item	For	Material
YDa 59	Room or Compound Thermostat	Bakelite
cYDb 12	Two-Temperature or Duplex Thermostat	Sheet steel

CONDUIT FITTINGS



Cast iron, black crinkle finish. To protect wires and provide surface mounting when ½" conduit is used on surface work.

Item	For
YDa 58-2	Room or Compound Thermostat
aYDj 227	Duct or Immersion Thermostat
eYCc 240	eYCc Damper Control Motor Terminal Block
aYCg 144	aYCg Damper Control Motor Terminal Block
cYDb 41	Two-Temperature or Duplex Thermostat
fYDh 5-1	Hygrostat, Room type
fYDh 11	Hygrostat, Duct type

MOUNTING FLANGES

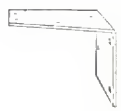
Item	For	Thread
aYDj 33	Duct or Immersion Thermostat	¾" Pipe, Tapered
aYDj 64	Thermometer	¾" Pipe, Straight
aYDj 54	Flange Mounting Screws for above	

ANGLE THERMOMETERS

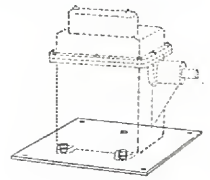
Item	Range, Degrees Fahrenheit
aYDj 94	30 to 100
aYDj 61	—20 to 120

MOUNTINGS FOR DAMPER CONTROL MOTORS

aYCg 79-1
eYCc 79-2



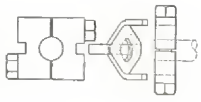
aYCg 203-1
eYCc 246



aYCg 124
eYCc 124

For	Description	For	Material
eYCc 124	Base Plate 7" by 8"	eYCc Damper Control Motor	Sheet Steel
aYCg 124	Base Plate 5" by 7"	aYCg Damper Control Motor	Sheet Steel
eYCc 79-2	Direct Mounting Bracket	eYCc Damper Control Motor	Cast Iron
aYCg 79-1	Direct Mounting Bracket	aYCg Damper Control Motor	Cast Iron
eYCc 246	Angle Bracket	eYCc Damper Control Motor	Sheet Steel
aYCg 203-1	Angle Bracket	aYCg Damper Control Motor	Sheet Steel

COUPLING



For coupling Damper Control Motor direct to shaft of damper. Assembly consists of two Discs and one Coupling unit.

Item	Description
eYCc 125-1	Coupling
eYCc 199-1	Coupling Disc for ½" Shaft (2 Req.)

POSITION INDICATING ARROW FOR DAMPER CONTROL MOTOR

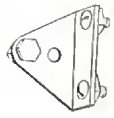
Well made steel arrow, which is attached to coupling to indicate the position of the damper.

Item	Description
eYCc 195	Large Arrow, 8"
eYCc 196	Small Arrow, 4"

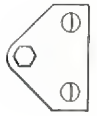
REMOTE POSITION INDICATOR

This electrically operated device consists of a transmitter and receiver which may be separated a maximum of 675 feet. The transmitter is attached to the door, damper or valve. The receiver indicates on its dial the position of the transmitter.

DAMPER CLIP



eYCc 198 Angle Clip for connecting linkage to damper louver.



eYCc 95 Straight Clip for connecting linkage to damper tie bar.

Miscellaneous Items Used in Installation of Temperature and Humidity Control Systems

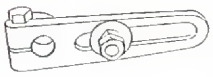
SIGNAL LIGHTS

For mounting in standard switch box. Can be furnished in either surface or flush type.

Item	Description
eYZp 9	22½-volt Signal Light, Rectangular Ruby Bulls Eye
eYZp 10	22½-volt Signal Light, Rectangular Emerald Bulls Eye
eYZp 11	22½-volt Signal Light, Rectangular Clear Bulls Eye

Multiple-light assemblies can be made to order.

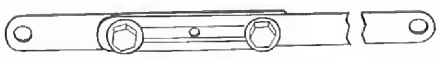
DAMPER CRANK



To be clamped on shaft of Damper Control Motor. Link bolt adjustable in slot.

Item	Center Distance, Shaft to Bolt	
	Minimum	Maximum
eYCc 158-1	⅝″	1½″
eYCc 137-1	⅞″	2½″
eYCc 81-1	1″	3¼″
eYCc 78-1	1″	5″
aYCk 89	3″	5″
aYCk 90	4″	7″
aYCk 91	6″	10″

DAMPER LINK

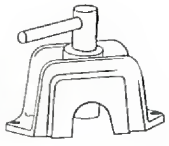


Each assembly consists of two pieces adjustably clamped together by screws through a slot in one piece.

Item	Center Distance, End Holes	
	Minimum	Maximum
−eYCc 117A	5¼″	6¾″
−eYCc 117B	6¾″	9¾″
−eYCc 117C	9¾″	14¼″
−eYCc 117D	14¼″	20¼″
−eYCc 117E	20¼″	26¼″
−eYCc 117F	26¼″	32¼″
+aYCk 92-1	13½″	21″
+aYCk 93	20¼″	26¼″

− Can be used with either aYCg or eYCc Damper Control Motor.
+ Can be used only with aYCk Damper Control Motor.

MANUAL VALVE CONTROL



For manual operation of Valves before Valve Operator units are installed. Complete with yoke.

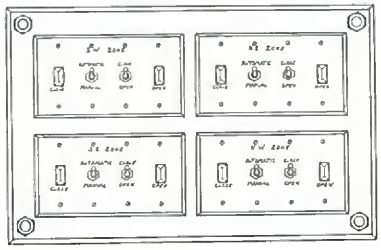
Item	For Valve Sizes
cYBa 57-1	½″ and ¾″
YBa 99-1	1″ to 2″

SWITCHES

Assembly consists of small toggle switches with operating lever and surface or flush plate, ready for mounting in standard switch box.* Plates marked as desired. Special assemblies for circuits not shown made to order.

Item	Contact Arrangement	Plate Type
sYZe 1	Single-pole, single-throw	Surface
sYZe 2	Single-pole, single-throw	Flush
sYZe 3	Single-pole, double-throw	Surface
sYZe 4	Single-pole, double-throw	Flush
sYZe 5	Double-pole, double-throw	Surface
sYZe 6	Double-pole, double-throw	Flush
sYZe 9	Four-pole, double-throw	Surface
sYZe 10	Four-pole, double-throw	Flush
sYZe 14	*Six-pole, double-throw	Flush
cYZe 923	Three-point	Surface
cYZe 924	Three-point	Flush
cYZe 921	Five-point	Surface
cYZe 922	Five-point	Flush
YZc 25	S.P.D.T. Self Restoring	Surface

* Six-pole switch requires box 2¾″ deep.



SWITCHBOARD PANELS

All switchboards are built to order. Sketch should be submitted to show arrangement desired.

ELECTRIC TIME SWITCHES

Enclosed in black japanned metal box. Single-pole, double-throw switch. Special switch combinations provided at extra cost.

Item	Make	Type	Week-end Cutout	Rating
x bYZp 1	Sangamo	Synchronous	Without	115v 60c
x bYZp 2	Sangamo	Synchronous	With	115v 60c
bYZp 3	G. E.	Telechron	Without	115v 60c
bYZp 4	G. E.	Telechron	Without	25v 60c
x bYZp 5	Sangamo	Electric-wound Escapement Movement	With	115v 60c
bYZp 58	Barber-Colman	Synchronous	Without	25v 60c

x Extra for viewing window. See Price List.

TRANSFORMER-RELAYS

Transformer and Relay enclosed in sheet metal box. Available for 60 cycle AC only.

Item	Contact Arrangement	Line Voltage	Coil Voltage	Coil Control	Capacity, Amps.	Transformer Cap., VA
cYZp 6	Single-pole Single-throw	115	25	2-wire Separate	15	5
cYZp 7	Single-pole Single-throw	230	25	2-wire Separate	15	5

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Miscellaneous Items Used in Installation of Temperature and Humidity Control Systems

RELAYS

Contact Arrangement	Item	Coil Voltage	Max. Load Amps. Non-Indc. 220 V or Less	Max. Load Amps. Non-Indc. 440 V or 550 V	H.P. Single Phase 115 V	H.P. Single Phase 230 V
Single Pole Single Throw Normally Open	cYZp 1–1	22½	15	.....	½	½
	cYZp 27	115	15	.....	½	½
	cYZp 27	230	15	.....	½	½
	cYZp 28	440	10	3	¼	½
	cYZp 28	550	10	3	¼	½
Double Pole Single Throw Normally Open	cYZp 2	22½	10	.....	½	¾
	cYZp 29	115	10	.....	½	¾
	cYZp 29	230	10	.....	½	¾
	cYZp 30	440	10	3	¼	½
	cYZp 30	550	10	3	¼	½
Single Pole Double Throw	cYZp 3–1	22½	10	.....	½	½
	cYZp 4–1	115	10	.....	½	½
	cYZp 5–1	230	10	.....	½	½
	cYZp 31	440	10	3	¼	½
	cYZp 31	550	10	3	¼	½
Double Pole Double Throw	cYZp 14	22½	4	.....	.....	.....
	cYZp 14	115	4	.....	.....	.....
	cYZp 14	230	4	.....	.....	.....
	cYZp 14	440	10	3	¼	½
	cYZp 14	550	10	3	¼	½
3 Pole Single Throw Normally Open Coil Energized	cYZp 15	22½	10	3	*¼	†½
	cYZp 15	115	10	3	*¼	†½
	cYZp 15	230	10	3	*¼	†½
	cYZp 15	440	10	3	*¼	†½
	cYZp 15	550	10	3	*¼	†½
3 Pole Single Throw Normally Closed Coil Energized	cYZp 16	22½	10	3	*¼	†½
	cYZp 16	115	10	3	*¼	†½
	cYZp 16	230	10	3	*¼	†½
	cYZp 16	440	10	3	*¼	†½
	cYZp 16	550	10	3	*¼	†½
3 Pole Double Throw Coil Energized	cYZp 17	22½	5	3	.....	.....
	cYZp 17	115	5	3	.....	.....
	cYZp 17	230	5	3	.....	.....
	cYZp 17	440	5	3	.....	.....
	cYZp 17	550	5	5	.....	.....

* 3 Phase rating ½ H.P.
† 3 Phase rating ¾ H.P.

INFORMATION REQUIRED WITH ORDER

1. Item Number.
2. Main Line Voltage.
3. Frequency (cycles).
4. Coil Voltage (control circuit).
5. Relay only or enclosed in steel box.

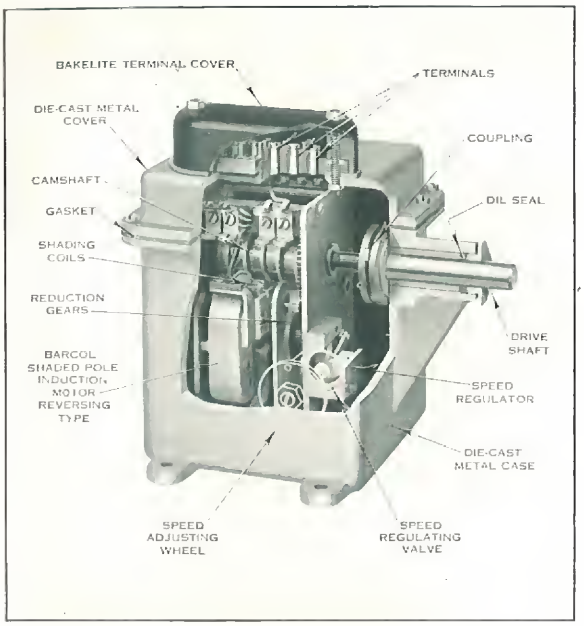
Contact Arrangement	Item	Coil Voltage	Max. Load Amps. 220 V or Less	Max. Load Amps. 440 V or 550 V
4 Pole Single Throw Normally Open Coil Energized	cYZp 18	22½	10	3
	cYZp 18	115	10	3
	cYZp 18	230	10	3
	cYZp 18	440	10	3
	cYZp 18	550	10	3
4 Pole Single Throw Normally Closed Coil Energized	cYZp 19	22½	10	3
	cYZp 19	115	10	3
	cYZp 19	230	10	3
	cYZp 19	440	10	3
	cYZp 19	550	10	3
4 Pole Double Throw Coil Energized	cYZp 20	22½	5	3
	cYZp 20	115	5	3
	cYZp 20	230	5	3
	cYZp 20	440	5	3
	cYZp 20	550	5	3

The following relays can be furnished with any combination of normally open or normally closed contacts.

5 Pole Coil Energized	cYZp 21	22½	5	3
	cYZp 21	115	5	3
	cYZp 21	230	5	3
	cYZp 21	440	5	3
	cYZp 21	550	5	3
6 Pole Coil Energized	cYZp 22	22½	5	3
	cYZp 22	115	5	3
	cYZp 22	230	5	3
	cYZp 22	440	5	3
	cYZp 22	550	5	3
7 Pole Coil Energized	cYZp 23	22½	5	3
	cYZp 23	115	5	3
	cYZp 23	230	5	3
	cYZp 23	440	5	3
	cYZp 23	550	5	3
8 Pole Coil Energized	cYZp 24	22½	5	3
	cYZp 24	115	5	3
	cYZp 24	230	5	3
	cYZp 24	440	5	3
	cYZp 24	550	5	3

Barber-Colman control equipment is listed as standard by the Underwriters' Laboratories.

Types	Service
Unidirectional, Reversible, Multi-Position, Stall Motor, Etc.	Regulation of All Types of Dampers



A Cut-away Illustration of a Reversible Type eYCc Damper Control Motor, showing the location of the various parts.

Controls: 3 wire low-voltage thermostat, single-pole double-throw switch, or equivalent, which may be a pressure actuated switch, electric time switch, relay, etc.

Power Requirements:

25 volt, 60 cycle, AC (115V, 60 cycle on aYCk).
Stall Motor types, 115 and 230 volts, 60 cycle, AC.
Control Motors for other voltages and frequencies on special order. 25 cycle units operate at approximately ¼ of the no load speed of 60 cycle units.

Standard Cam Arrangements: All groups except DC 100, DC 400 and DC 600 have available two or more auxiliary switches (in addition to those used for limiting travel) which may be used for controlling other apparatus, for signalling, for interlocks, etc. Standard units are available with several of the most used combinations which have standard designations as follows:

Positive Series—Used on DC 200 and DC 300 control motors—two auxiliary circuits (connected internally to hot line)—one closed in each of the two positions (two of four positions on DC 300 units).

Cams A—Used on DC 500 control motors—two auxiliary circuits (grounded internally) one closed only at end of CW travel and one closed only at end of CCW travel.

Reversing Series—Used on DC 500 control motors—two auxiliary circuits—(one connected to each starting circuit)—one closed only at end of CW travel and one closed only at end of CCW travel.

Cams B—Used on DC 500 control motors—two auxiliary circuits (grounded internally) one open only at end of CW travel and one open only at end of CCW travel.

Cams C—Used on DC 500 control motors—two auxiliary circuits (connected internally to hot line) one open only at end of CW travel and one closed only at end of CW travel.

Cams D—Same as "Cams C" except operation occurs at end of CCW travel.

GENERAL INFORMATION

Purpose: Damper Control Motors were originally designed for the regulation of single or multi-louvred dampers used in warm air heating systems, ventilating ducts, air conditioning systems and similar applications, but they are also useful as a power or driving unit where adjustable speed and accurate positioning with remote control is desired. For damper regulation, the control motor is connected to the damper either directly or by a linkage and positions it according to the demand transmitted by a thermostat or other controlling device. When used as a power device the method of connection (not supplied) will be varied to suit each application.

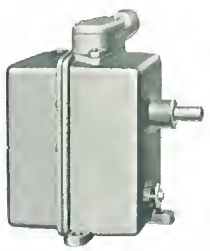
Construction: A Barcol shaded pole induction motor, through reduction gears, drives the main shaft of the Damper Control Motor which is connected by a coupling or suitable linkage, to the damper or other driven device.

The entire mechanism is immersed in oil, and carefully sealed in a cast case, insuring long life and quiet reliable operation. The oil, in addition to constantly lubricating all moving parts, insures quietness and serves as an effective means for rapidly dissipating the heat developed if continuous operation of the control motor is required. Automatic cam-operated switches permit accurate stopping at the desired limits of shaft rotation. Auxiliary cam-operated switches permit operation of additional apparatus, which may be controlled and operated in a definite sequence.

Positive types (unidirectional motor) rotate in one direction only and stop automatically at designated positions. Reversible types rotate in either direction as called for by thermostat or switch, and may stop (with possibility of restarting in either direction) at any point between limiting positions. The speed governing device provided on oil-immersed control motors consists of a small reciprocating pump with externally adjustable discharge orifice which restricts oil flow and thereby produces slower motor rotation without reducing the torque. The pump assembly is omitted on reversible control motors described as having no speed adjustment.

External electrical connections are made at terminals under the cover on top of the case of oil-immersed units. Bakelite cover standard on aYCg and eYCc. ½" condulet fitting can be supplied at additional cost. ¾" condulet fitting standard on aYCk.

An aYCg Adjustable Speed Reversible Damper Control Motor, One-Sixth Actual Size.



An aYCk Adjustable Speed Reversible Damper Control Motor, One-Eighth Actual Size.

The damper control motors described on this data sheet are part of the Barber-Colman Electric System of Temperature and Humidity Control. Other units for which similar information is available include:

Thermostats, all kinds	Butterfly Valves
Hygrostats	Packless Radiator Valves
Throttling Valves	Single Seat Packed Valves
Three-way Valves	Semi-Balanced Packed Valves
Solenoid Valves	Full-Balanced Packed Valves

BARBER-COLMAN COMPANY, Rockford, Illinois

RETURNED MATERIAL—When material is returned to us under circumstances over which we have no control, there will be a re-stocking charge of not less than 10% of the net selling price. All shipments of material for repair or replacement must be sent with carrying charges prepaid.

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Types	Service
Unidirectional, Reversible, Multi-Position, Stall Motor, Etc.	Regulation of All Types of Dampers

SPECIFICATIONS and DIMENSIONS

Group No.	Type and Characteristics	Torque, Lb. In.	Timing in Secs. per 360° at No Load	Input				Shading Coil Current, Amps.	Capacity, Size of Damper, Sq. Ft.
				Running		Standing			
				Amps.	Watts	Amps.	Watts		
DC 100	**Stall Damper Control Motors** 2 Wire control—for use on small dampers such as recirculating or fresh air dampers in unit ventilators. Stalled motor holds damper in open position. Spring or weight (not furnished with control motor) returns damper and control motor to original position following current shut off or failure, so that damper will be closed when fan motor is not running. Available for 115 or 230 volts, clockwise or counter-clockwise rotation.								
	101—Air-cooled—class bYCh—see Fig. 1 for dimensions—mechanism mounted in sheet metal case.								
	Fixed Speed—115 Volt	13	8	0.30	20	.....	.....	.....	5
	230 Volt	13	8	0.15	20	.....	.....	.....	5
	102—Oil-immersed—class cYCh—see Fig. 2 for dimensions—similar mechanism to class bYCh except immersed in oil—no speed adjustment but available in 2 speeds.								
	Fixed Speed—115 Volt	25	15	0.4	25	.....	.....	.....	10
	230 Volt	25	15	0.2	25	.....	.....	.....	10
	115 Volt	25	8	0.4	25	.....	.....	.....	10
	230 Volt	25	8	0.2	25	.....	.....	.....	10
DC 200	**Unidirectional (Positive) Damper Control Motors** 3 Wire control—2 position. Stop at two positions only, generally 180° apart—thermostat control except as noted. Oil immersed units with speed adjustment available as specials.								
	201—Air cooled—class aYCg—see Fig. 3 for dimensions—standard units for SPDT switch control only. Available for thermostatic control as special. Fixed Speed—25 Volt	45	150	0.8	10	.....	.....	.....	15
	202—Oil-immersed—class aYCg—see Fig. 4 for dimensions—standard units are without speed adjustment.								
	Fixed Speed—25 Volt	100	190	1.8	25	.....	.....	.....	35
	204—Oil-immersed—class eYCc—see Fig. 6 for dimensions—standard units are without speed adjustment—available in two speeds.								
	Fixed Speed—25 Volt	80	44	2.3	30	.....	.....	.....	30
	25 Volt	175	120	2.3	30	.....	.....	.....	50
	206—Oil-immersed—class aYCk—for switch operation only—see Fig. 8 for dimensions—standard units are available with or without speed adjustment—available for either 25 or 115 volt.								
	Fixed Speed— 25 Volt	750	120	4.8	70	.....	.....	.....	.....
	115 Volt	750	120	1.1	70	.....	.....	.....	.....
	Adj. Speed— 25 Volt	750	120–1200	4.8	70	.....	.....	.....	.....
	115 Volt	750	120–1200	1.1	70	.....	.....	.....	.....
DC 300	**Unidirectional (Positive) Positioning Damper Control Motors** 3 Wire thermostat control except as noted—4 stops. These units are designed primarily for direct connection to single louvre dampers without stops. Operation is usually through 90° strokes, opening the damper on one stroke, closing it on the next, etc. The damper, of course, must be free to revolve continuously in one direction. With this construction, one revolution of the control motor completes two full cycles (open and closed) of the damper.								
	301—Air cooled—class aYCg—see Fig. 3 for dimensions.								
	Fixed Speed— 25 Volt	45	150	0.8	10	.....	.....	.....	15
	302—Oil-immersed—class aYCg—see Fig. 4 for dimensions—standard units are without speed adjustment.								
	Fixed Speed— 25 Volt	100	190	1.8	25	.....	.....	.....	35
	304—Oil-immersed—class eYCc—see Fig. 6 for dimensions—special units only. Fixed Speed— 25 Volt	175	120	2.3	30	.....	.....	.....	50
	306—Oil-immersed—class aYCk—for switch operation only—see Fig. 8 for dimensions—special units only.								
	Fixed Speed— 25 Volt	750	120	4.8	70	.....	.....	.....	.....
	115 Volt	750	120	1.1	70	.....	.....	.....	.....

Types	Service
Unidirectional, Reversible, Multi-Position, Stall Motor, Etc.	Regulation of All Types of Dampers

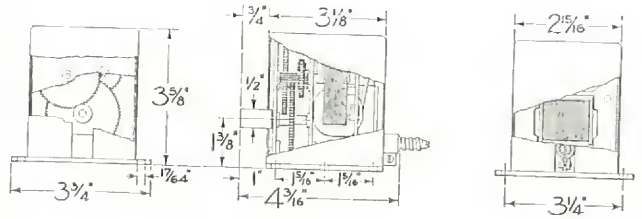
SPECIFICATIONS and DIMENSIONS (Continued)

Group No.	Type and Characteristics	Torque, Lb. In.	Timing in Secs. per 360° at No Load	Input				Shading Coil Current, Amps.	Capacity, Size of Damper, Sq. Ft.
				Running		Standing			
				Amps.	Watts	Amps.	Watts		
DC 400	**Unidirectional (Positive) Multi-position Damper Control Motors** Multi-point switch control—these units can be positioned in any one of four (or five) positions as selected at a remote control point—rotation in one direction only to reach desired position—positions are normally in first 90° or 180° of travel.								
	401—Air cooled—four position—class aYCg—see Fig. 3 for dimensions—special units only Fixed Speed— 25 Volt	45	150	0.8	10	.....	.....	.....	15
	402—Oil-immersed—four position—class aYCg—see Fig. 4 for dimensions—special units only. Fixed Speed— 25 Volt	100	190	1.8	25	.....	.....	.....	35
	404—Oil-immersed—five position—class eYCc—see Fig. 6 for dimensions—standard units are without speed adjustment. Fixed Speed— 25 Volt	175	120	2.3	30	.....	.....	.....	50
	406—Oil-immersed—five position—class aYCk—see Fig. 8 for dimensions (only one motor used for unidirectional units)—special units only. Fixed Speed— 25 Volt	750	120	4.8	70	.....	.....	.....	.....
	115 Volt	750	120	1.1	70	.....	.....	.....	.....
DC 500	**Reversible (Modulating) Damper Control Motors** 3 Wire thermostat control except as noted—these units can be stopped, restarted in original direction or reversed, at any point—limiting positions are usually 90° or 180° apart.								
	502—Oil-immersed—class aYCg—see Fig. 5 for dimensions—standard units with or without speed adjustment. Fixed Speed— 25 Volt	50	190	0.9	12	0.85	8	0.33	20
	Adj. Speed— 25 Volt	50	190–1900	0.9	12	0.85	8	0.33	20
	504—Oil-immersed—class eYCc—see Fig. 7 for dimensions—standard units with or without speed adjustment. Fixed Speed— 25 Volt	220	225	2.3	30	2.3	21	0.46	75
	Adj. Speed— 25 Volt	220	225–2250	2.3	30	2.3	21	0.46	75
	506—Oil-immersed—class aYCk—for switch operation only—see Fig. 8 for dimensions—standard units with or without speed adjustment. Fixed Speed— 25 Volt	750	120	4.8	70	.....	.....	.....	.....
	115 Volt	750	120	1.1	70	.....	.....	.....	.....
	Adj. Speed— 25 Volt	750	120–1200	4.8	70	.....	.....	.....	.....
	115 Volt	750	120–1200	1.1	70	.....	.....	.....	.....
DC 600	**Reversible Multi-position Damper Control Motors** Multi-point switch control—these units can be positioned in any one of four (or five) positions as selected at a remote control point—rotation in either direction as necessary to reach desired position—limits of travel are 90° or 180°.								
	602—Oil-immersed—four position—class aYCg—see Fig. 5 for dimensions—standard units with or without speed adjustment. Fixed Speed— 25 Volt	50	190	0.9	12	0.85	8	0.33	20
	Adj. Speed— 25 Volt	50	190–1900	0.9	12	0.85	8	0.33	20
	604—Oil-immersed—five position—class eYCc—see Fig. 7 for dimensions—standard units with or without speed adjustment. Fixed Speed— 25 Volt	220	225	2.3	30	2.3	21	0.46	75
	Adj. Speed— 25 Volt	220	225–2250	2.3	30	2.3	21	0.46	75
	606—Oil-immersed—five position—class aYCk—see Fig. 8 for dimensions—standard units with or without speed adjustment. Fixed Speed— 25 Volt	750	120	4.8	70	.....	.....	.....	.....
	115 Volt	750	120	1.1	70	.....	.....	.....	.....
	Adj. Speed— 25 Volt	750	120–1200	4.8	70	.....	.....	.....	.....
	115 Volt	750	120–1200	1.1	70	.....	.....	.....	.....

Types	Service
Unidirectional, Reversible, Multi-Position, Stall Motor, Etc.	Regulation of All Types of Dampers

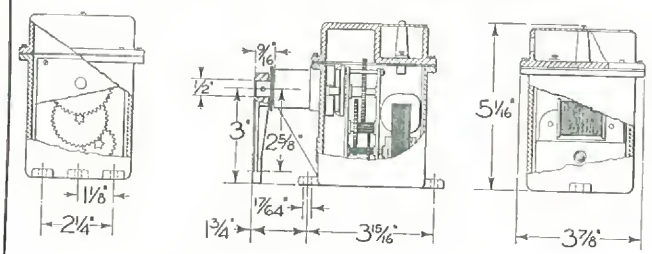
SPECIFICATIONS and DIMENSIONS (Continued)

Fig. 1—bYCh Air-Cooled Stall Motor



24" Leads Furnished as Standard

Fig. 2—cYCh Oil-Immersed Stall Motor



Crank Arm Furnished as Standard
Must Be Mounted on Horizontal Surface or with Shaft Up

Fig. 3—aYCg Air-Cooled Unidirectional

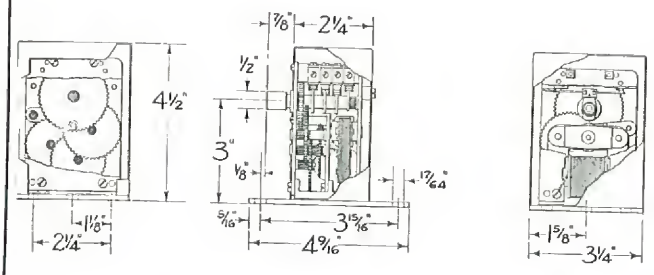


Fig. 4—aYCg Oil-Immersed Unidirectional

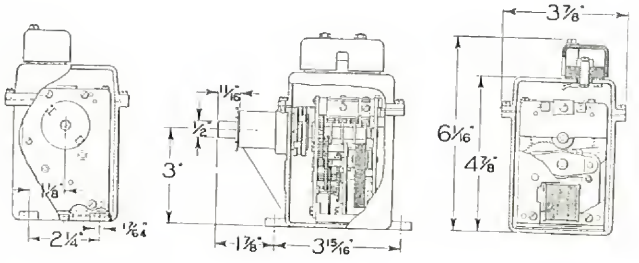


Fig. 5—aYCg Oil-Immersed Reversible

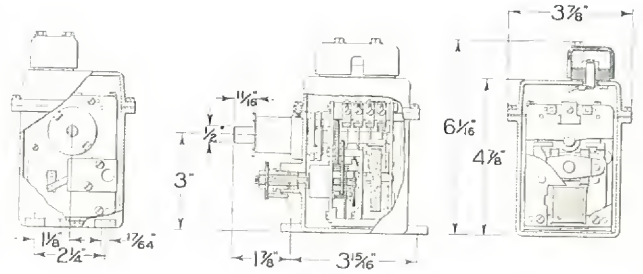


Fig. 6—eYCc Oil-Immersed Unidirectional

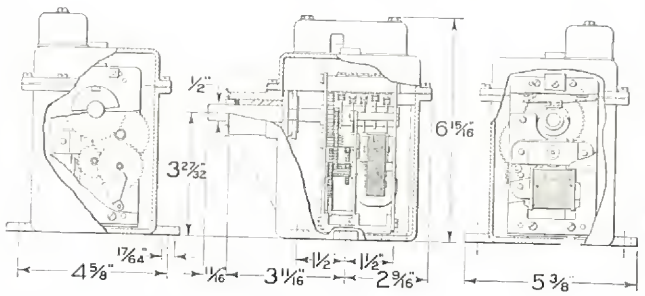


Fig. 7—eYCc Oil-Immersed Reversible

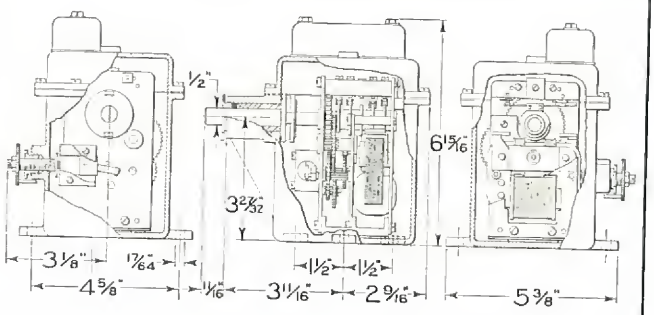
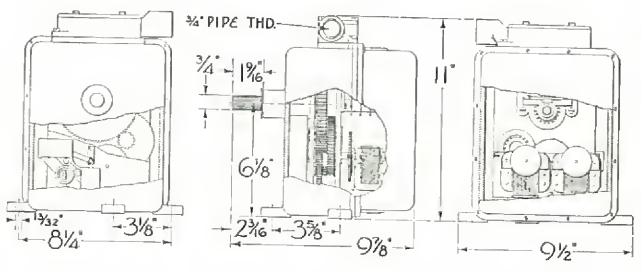


Fig. 8—aYCk Oil-Immersed
Unidirectional or Reversible



Microtrol	Reversible Damper Control Motors
Program Switches	Motor Driven Contact-Making Mechanisms

MICROTROL

Uses: Microtrol is a Damper Control Motor for use in a Micro Control System, in combination with a Microtherm and Microvalve. For accurate regulation of single or multi-louvred dampers in warm air heating systems, ventilating ducts, air conditioning systems, unit ventilators, and similar applications. Also as a power or driving unit or multi-positioning device where remote control is desired.

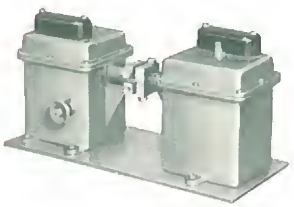
Construction: Identical with corresponding Damper Control Motors, except with the addition of a potential dividing rheostat, the arm of which is driven directly from the power output shaft. All parts enclosed within the die-cast case and immersed in oil.

Size: Same as corresponding Damper Control Motor.

Part Number: Any Damper Control Motor in Group 502 or 504 can be ordered as Microtrol by adding the suffix -M; e.g., aYCg 584-M. If it is to be used in a reversing series combination with other Micro units, add the suffix R; e.g., aYCg 631-MR (Damper Control Motor must be selected which has auxiliary switches arranged for reversing series).

Note: Unless otherwise specified, Microtrol will be wired (internally) so that it will rotate in a counter-clockwise direction (facing end of shaft) when responding to a call for heat, and clockwise when responding to a call for cooling.

PROGRAM SWITCHES



Program Switches, motor driven contact-making mechanisms, are available in the following standard types and combinations. Special Program Switches may be obtained with any combination of sequences that may be possible using the maximum number of switches; a complete description of the results to be obtained should be submitted to the factory.

Momentary Contact: For shifting groups of Two-Temperature Thermostats at definite intervals. Each circuit may be used to shift as many as eight Two-Temperature Thermostats from day to night, and vice versa.

Holding Contact: For controlling operation of solenoid valves or relays. Switches make contact in one direction of rotation, and break contact in the opposite direction. They close in progressive sequence, after definite intervals, and open in the reverse sequence. One circuit required for each valve or relay.

Positive Valve Control: For control (no relays required) of positive motor operated valves in steam jet refrigeration, sprinkler systems, etc. Switches make contact in one direction of rotation, and break contact in the opposite direction. They close in progressive sequence, after definite intervals, and open in the reverse sequence. One circuit required for each motor operated valve.

Progressive Compressor Control: For control (through relays) of a number of compressors in an air conditioning system. Similar to Holding Contact Program Switch, except an interlocking circuit gives protection in the event of power failure by returning the switch to the "off" position before any compressors may be re-started. One cYZp 1-1 relay is required for each compressor, and one cYZp 4595 relay for each Program Switch.

Selective Compressor Control: Similar to Progressive Compressor Control Switches, except there is a centrally located "off" position, from which rotation in one direction will give a desired sequence of operation, and rotation in the other direction will give the reverse sequence of operation. For reversing the operating sequence of compressors to equalize the wear. Reversal of the sequence is made by a time switch (not part of Program Switch) which operates only when one or more compressors are running, so that the change-over is based on actual hours of operating time.

Construction: Motor Operated Program Switches resemble an cYCg or eYCc Damper Control Motor. They may be either single or double units, one directly connected to and driving the other unit, depending upon the number of circuits required. See specifications below for further information on standard switches. Special switches may be obtained by submitting a complete description of the results to be accomplished to the factory for recommendations.

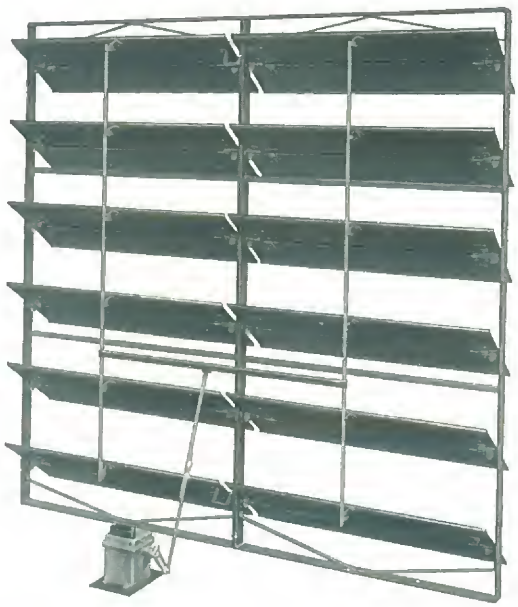
Part No.	Service	No. of Circuits	Timing Sec./180°	Type	Driving Member	Volts	Freq.	VA	Driven Member
YBa 4211	Momentary Contact	2	20	Uni-directional	YBa	25	60	50	None
YBa 4200-2	Momentary Contact	2	100	Uni-directional	YBa	25	60	52.5	None
eYCc 4140	Momentary Contact	3	Adjustable 60–600	Uni-directional	eYCc	25	60	57.5	None
eYZf 4269	Momentary Contact	5	75	Uni-directional	aYCg	25	60	20	aYCg
eYZf 4218	Momentary Contact	8	Adjustable 60–600	Uni-directional	eYCc	25	60	57.5	eYCc
cYZf 4219	Momentary Contact	12	75	Uni-directional	aYCg	25	60	20	Special Switch
cYZf 4220	Momentary Contact	18	75	Uni-directional	aYCg	25	60	20	Special Switch
aYCg 4178	Holding Contact	2	Adjustable 100–1000	Reversible	aYCg oil immersed	25	60	22.5	None
eYCc 4179	Holding Contact	3	Adjustable 110–1100	Reversible	eYCc oil immersed	25	60	57.5	None
eYZf 4180	Holding Contact	6	Adjustable 100–1000	Reversible	aYCg oil immersed	25	60	22.5	aYCg
eYZf 4181	Holding Contact	8	Adjustable 110–1100	Reversible	eYCc oil immersed	25	60	57.5	eYCc
eYZf 4221	Positive Valve Control	3	Adjustable 100–1000	Reversible	aYCg oil immersed	25	60	22.5	aYCg
eYZf 4222	Positive Valve Control	4	Adjustable 110–1100	Reversible	eYCc oil immersed	25	60	57.5	eYCc
eYCc 4614	Progressive Compressor Control	2	Adjustable 110–1100	Reversible	eYCc oil immersed	25	60	57.5	None
eYZf 4169-1	Progressive Compressor Control	3	Adjustable 100–1000	Reversible	aYCg oil immersed	25	60	22.5	aYCg
eYZf 4223	Progressive Compressor Control	4	Adjustable 100–1000	Reversible	aYCg oil immersed	25	60	22.5	aYCg
eYZf 4270	Progressive Compressor Control	5	Adjustable 100–1000	Reversible	aYCg oil immersed	25	60	22.5	aYCg
eYZf 4225	Selective Compressor Control	3	Adjustable 100–1000	Reversible	aYCg oil immersed	25	60	22.5	aYCg
eYZf 4206	Selective Compressor Control	4	Adjustable 110–1100	Reversible	eYCc oil immersed	25	60	57.5	eYCc
eYZf 4262	Selective Compressor Control	5	Adjustable 110–1100	Reversible	eYCc oil immersed	25	60	57.5	eYCc

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Types	Service
Single, Multi-Louvred, and Mixing Dampers	Regulation of Air Flow

APPLICATION OF DAMPER CONTROL MOTORS TO VARIOUS TYPES OF DAMPERS

Two Damper Control Motors Connected by Linkage to Multi-Louvred Intake Damper

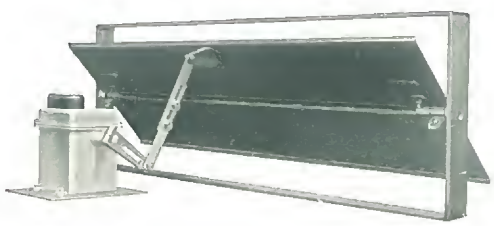


Single Damper Control Motor Connected by Linkage to Multi-Louvred Damper

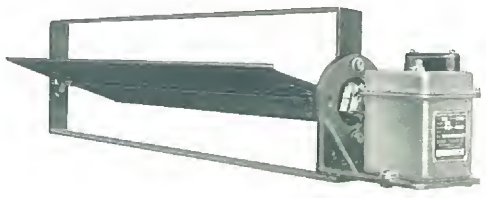
Damper Control Motor Direct Connected to Three Louvre Damper

Damper Control Motor Direct Connected to Mixing Damper

Damper Control Motor Connected by Linkage to Three Louvre Damper



Damper Control Motor Connected by Linkage to Single Louvre Damper



Damper Control Motor Direct Connected to Single Louvre Damper

Barber-Colman control equipment is listed as standard by the Underwriters' Laboratories.

Circuits	Rating	Service
Two-Wire or Three-Wire	2.5 Amps., 25 Volts, AC	Automatic Relative Humidity Control

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Four views of the Barber-Colman Hygrostats, showing details of the case and mechanism. Fig. 1 shows the complete instrument, wall type, with cover on as it appears in use. In Fig. 2 the cover has been removed to show the location of the two ribbons of human hairs, the tongue and detents, and other details of the mechanism. Fig. 3 is the rear of the instrument, showing the binding posts and other details. Fig. 4 shows the Insertion type Hygrostat. The operating mechanism is identical with the Wall type.

GENERAL DESCRIPTION

The rapid development of air conditioning and its expansion into practically every branch of industry as well as into the home, office, hotel, theatre, hospital, public building, etc., has given rise to the need for an accurate automatic control directly sensitive to relative humidity yet unaffected by temperature fluctuation. As a result of this need the Hygrostat described here has been developed. The functioning of this instrument is somewhat similar to that of the familiar room thermostat, but instead of its actuating element being heat sensitive, the electric contacts are controlled by a special element highly sensitive to the moisture content of the air.

This element consists of a large number of human hairs, each hair being separately mounted, tensioned, and ventilated. This multiple hair element has remarkable strength and durability, and is protected against damage in shipment or service. Close study has perfected a method of treating these elements so as to free them from calibration shift and render them entirely reliable over long periods of service.

The scale on the disc above the adjusting knob is marked directly in relative humidity instead of the usual meaningless arbitrary figures. The Hygrostat will provide reliable automatic control with a standard differential of only 1% relative humidity. This differential between the point of starting and stopping the controlled apparatus can be increased if desired. The instrument is suitable for the automatic control of all types of humidifying or de-humidifying equipment in industrial and domestic applications.

Detents, consisting of a pair of small permanent magnets mounted alongside the tongue (see Fig. 2) are supplied on all Hygrostats. They provide snap action motion of the tongue from one contact to the other, prevent pitting or burning of the contacts from arcing due to vibration or other causes, and permit use of the instrument on two-wire circuits.

To prevent tampering with the setting of the Hygrostat, a special ventilated guard to fit over the whole instrument can be furnished. The regular adjusting knob is omitted and its shaft is milled off so that a special wrench must be inserted through an opening in the guard in order to change the setting. When the Hygrostat is used in factories, schoolrooms, theatres, meeting halls, libraries, and other similar places where unauthorized persons might be inclined to try to change the adjustment, this arrangement will avoid trouble. The Hygrostat is not furnished for adjustment by special wrench without the guard, as the milled shaft protrudes from the cover and could be turned with the fingers.

CONSTRUCTION AND METHOD OF OPERATION

As may be seen from the illustration of the Hygrostat with its cover removed (Fig. 2), the two ribbons of human hair which comprise the sensitive element are vertically mounted one on each side of the unit. The bottom end of the left-hand ribbon is adjustably anchored. The two ribbons are connected at the top by a rocker arm or lever having a fulcrum which is moved by the setting knob. The bottom end of the right-hand ribbon is connected to the short arm of a bell-crank on the other end of which is the moving silver contact. The magnetic detents to provide snap action are mounted on each side of this longer arm or tongue.

The operation of the control is as follows: Human hair has the property of lengthening and shortening appreciably with changes in the moisture content of the air surrounding it. Consequently, as the humidity drops, the hairs shorten slightly and pull the end of the tongue over against the left-hand or "more moisture" contact, causing the controlled apparatus to raise the relative humidity. Conversely, as the humidity rises, the hairs elongate until the tongue snaps over against the right-hand contact, shutting off the moisture supply. A spring yield device is provided to prevent damage to the element from excessive tension developed in atmospheres of lower humidity than that for which the instrument may be set.

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Service	Rating	Circuits
Automatic Relative Humidity Control	2.5 Amps., 25 Volts, AC	Two-Wire or Three-Wire

Application: To control humidifying or de-humidifying apparatus for domestic and industrial application by operation of motor-operated valves, damper control motors, solenoid valves, or relays.

Element: Multiple human hair. Durable in service, needs no adjustment, free from dust deposit trouble.

Sensitivity: Extremely rapid response to either rise or fall of relative humidity. Unaffected by temperatures up to 175 F.

Accuracy: Standard operating differential is 1% relative humidity. This can be increased if required.

Setting: By fluted knob which turns graduated disc having an accurate scale reading directly in per cent relative humidity.

Range: Adjustable from 20% to 90% relative humidity. (See note below concerning use in high humidities.) Maximum temperature, 175 F.

Case: Cadmium plated pressed steel with independent strain-proof mounting of mechanism. Thorough circulation of air past sensitive element insured by numerous openings on sides and bottom of cover.

Finish: Brown lacquer, to match color and finish of bakelite cases on Barber-Colman thermostats.

Connections: Heavy binding posts provided in recessed back plate. Everything fully insulated. All connections made without removing instrument cover. Suitable for either two-wire or three-wire low voltage circuits.

Contacts: Fine silver used for all contacts. Rating is 2.5 amperes at 25 volts, AC. Relays and other devices for using the Hygrostat on heavier loads are available and information will be furnished on request.

Dimensions: 7½" high, 2⅛" wide, 1¼" deep. Weight, 9 oz.

SPECIFICATIONS

Item	Mounting	Adjustment	Scale Marking	Range	Calibration Point	Differential	Detents
fYDh 185	Wall	Dial	Numerical	20% — 90%	60%	2%	Yes
fYDh 186	Wall	Knob	"Increase—Decrease"	20% — 90%	70%	2%	Yes
fYDh 187	Wall	Dial (Lock Type)	Numerical	20% — 90%	60%	2%	Yes
fYDh 188	Insertion	Indicator	Numerical	20% — 90%	60%	2%	Yes
fYDh 4370	Wall	Dial (Lock Type)	Numerical	20% — 90%	Special	2%	Yes
fYDh 4435	Wall	Dial	Numerical	20% — 90%	Special	2%	No
fYDh 4459	Wall	Dial	Numerical	20% — 90%	Special	2%	Yes
fYDh 4461	Insertion	Indicator	Numerical	20% — 90%	Special	2%	Yes

SPECIAL NOTE: HIGH HUMIDITIES

In all cases, and especially where high humidities are to be controlled, care should be used in locating the instrument, if satisfactory performance over the entire range is to be assured. For instance, if the Hygrostat is mounted on a cold wall, condensation upon it from an atmosphere of high humidity may occur, and although the hygroscopic element is undamaged by contact with water, it obviously will not respond to the true humidity of the room under such conditions. Also, such condensation will, if introduced between the contact points, cause excessive burning and premature failure. It is suggested that full details of the proposed installation be submitted to our engineers for their recommendation in cases where humidities over 70% are to be controlled or where other conditions might render the satisfactory operation of the device questionable.

The Hygrostats described on this data sheet are part of the Barber-Colman Electric System of Temperature and Humidity Control. Other units for which similar information is available include:

Thermostats, all kinds	Solenoid Valves
Packless Radiator Valves	Butterfly Valves
Single Seat Packed Valves	Throttling Valves
Semi-Balanced Packed Valves	Three-way Valves
Full-Balanced Packed Valves	Damper Control Motors, Positive or Reversing

BARBER-COLMAN COMPANY
Rockford, Illinois

RETURNED MATERIAL

When material is returned to us under circumstances over which we have no control, there will be a re-stocking charge of not less than 10% of the net selling price.

All shipments of material for repair or replacement must be sent with carrying charges prepaid.

Barber-Colman control equipment is listed as standard by the Underwriters' Laboratories.

Description
Temperature-Sensitive Instruments for Controlling Motor-Operated Valves, Damper Control Motors, Relays, Etc.

GENERAL DESCRIPTION

Barber-Colman Thermostats are made for high-voltage, low-voltage, two-wire and three-wire control circuits. A bimetal temperature-sensitive element warps with temperature changes and moves a current-carrying tongue against one or the other of two fixed contact points, thus closing circuits which control other equipment. "Detents" (small permanent magnets), to provide snap-action movement of the tongue from one contact to the other and prevent "chattering", are available on nearly all types as shown in the specifications. The mechanisms are mounted in bakelite cases of small size and pleasing appearance. Special cover screws, which can be removed only with a special wrench, can be provided to prevent tampering.

These thermostats are made to operate on a small differential and consequently will, other conditions being favorable, provide accurate temperature control with minimum variations from the desired point. A sufficient number of types and varieties of instruments are available to provide proper control for any kind of heating, ventilating, or air conditioning system. Many "special" models are available, in addition to the standard ones listed here. Inquiries are solicited concerning any special applications.

ROOM THERMOSTAT

Uses: For wall mounting in spaces which are to be maintained at usual room temperatures.

Construction: Single unit, consisting of bimetal element, tongue, contacts, adjusting means, and detents (when specified). Bakelite base, bakelite ventilated cover with thermometer. Three coded binding posts under base. Four screw holes in base for mounting. All instruments are made with adjustable U-shaped stops which can be set for high or low limit or for positive locked position. Positive Closing type will hold controlled valve(s) or damper(s) closed when set at minimum on scale. Positive Opening type holds controlled unit(s) open when at maximum setting.

See also Duplex Thermostat, Two-Temperature Thermostat, Totally-Enclosed Room Thermostat, and Heater Thermostat for related types.

Dimensions: 2⅛" wide, 5⅜" high, 1¾" deep.

Part No.	Thermometer	Adjustment	Detent	Scale	Differential	Calibrated at
*YDa 286	Yes	Outside	Yes	55°—85°	2°	70°
*YDa 287	Yes	Outside	Yes	40°—70°	2°	55°
YDa 290	Yes	Outside	No	55°—85°	1½°	70°
YDa 291	Yes	Outside	Yes	55°—85°	2°	70°
°YDa 292	No	Inside	No	55°—85°	1½°	70°
°YDa 293	No	Inside	Yes	55°—85°	2°	70°
°YDa 294	Yes	Inside	No	55°—85°	1½°	70°
°YDa 295	Yes	Inside	Yes	55°—85°	2°	70°
YDa 296	Yes	Outside	No	40°—70°	1½°	55°
YDa 297	Yes	Outside	Yes	40°—70°	2°	55°
°YDa 298	No	Inside	No	40°—70°	1½°	55°
°YDa 299	No	Inside	Yes	40°—70°	2°	55°
°YDa 300	Yes	Inside	No	40°—70°	1½°	55°
°YDa 301	Yes	Inside	Yes	40°—70°	2°	55°
‡YDa 304	Yes	Outside	No	55°—85°	1½°	70°
‡YDa 305	Yes	Outside	Yes	55°—85°	2°	70°
+YDa 306	Yes	Outside	No	55°—85°	1½°	70°
+YDa 307	Yes	Outside	Yes	55°—85°	2°	70°

TOTALLY-ENCLOSED ROOM THERMOSTAT

Uses: For rooms or other enclosed spaces in which extremely high relative humidity is maintained, or in which the air is very dusty.

Construction: Identical with standard Room Thermostat except for cover, adjusting means, and seal. One-piece metal cover, gasket under edge. Internal adjustment same as standard, with addition of a spring bronze strip, attached to element, which contacts cover to effect normal response to temperature changes. Base, binding posts, detents, etc., same as standard.

Dimensions: 2⅛" wide, 5⅜" high, 2¼" deep.

Part No.	Thermometer	Adjustment	Detent	Scale	Differential	Calibrated at
°YDa 308	No	Inside	No	55°—85°	1½°	70°
°YDa 309	No	Inside	Yes	55°—85°	2°	70°
°YDa 310	Yes	Inside	No	55°—85°	1½°	70°
°YDa 311	Yes	Inside	Yes	55°—85°	2°	70°

* For 115 V., all others for 25 V.
\+ Positive opening switch.
‡ Positive closing switch.
° Lock Cover Screws—require special wrench YDa 41-2.

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Description

Temperature-Sensitive Instruments for Controlling Motor-Operated Valves, Damper Control Motors, Relays, Etc.

HEATER THERMOSTAT

Uses: For controlling throttling type Valve Operators or reversible Damper Control Motors from room temperature or, with slightly different construction, for controlling positive type motor units in "Compensated Control" systems.

Construction: Same as Room, Two-Temperature, or Duplex Thermostat, with addition of small resistance-heater unit inside case and beneath element. In Two-Temperature or Duplex Thermostat, heater is under "Day" element only. Heater connected between White and Blue binding posts. On "Compensated Control" system type, heater is connected between Red and a separate binding post (see literature describing "Compensated Control" system).

Dimensions: Same as corresponding Room, Two-Temperature, or Duplex model.

Part No.	Type	Therm.	Adjustment	Detent	Scale		Control Point When Set at Center of Dial		Heater Coil	Use
							Day	Nite		
YDa 232	Single	Yes	Outside	Yes	Cool—Warm		70°		750 ohm.	Reversible
°YDa 233	Single	No	Inside	Yes	Cool—Warm		70°		750 ohm.	aYCg & cYBf
°YDa 234	Single	Yes	Inside	Yes	Cool—Warm		70°		750 ohm.	" " "
YDa 235	Single	Yes	Outside	Yes	Cool—Warm		70°		2000 ohm.	Reversible
°YDa 236	Single	No	Inside	Yes	Cool—Warm		70°		2000 ohm.	eYCc & cYBc
°YDa 237	Single	Yes	Inside	Yes	Cool—Warm		70°		2000 ohm.	" " "
YDa 302	Single	Yes	Outside	Yes	55°—85°		70°		2000 ohm.	Compensated
°YDa 303	Single	Yes	Inside	Yes	55°—85°		70°		2000 ohm.	Control
cYDb 263	Duplex	Yes	Outside	Yes	Day Cool-Warm	Nite 40°–70°	Day 70°	Nite 55°	750 ohm.	"
°cYDb 264	Duplex	Yes	Inside	Yes	Cool-Warm	40°–70°	70°	55°	750 ohm.	Reversible
cYDb 265	Duplex	Yes	Outside	Yes	Cool-Warm	40°–70°	70°	55°	2000 ohm.	aYCg & cYBf
°cYDb 266	Duplex	Yes	Inside	Yes	Cool-Warm	40°–70°	70°	55°	2000 ohm.	" " "
cYDb 267	Duplex	Yes	Outside	Yes	55°–85°	40°–70°	70°	55°	2000 ohm.	Reversible
°cYDb 268	Duplex	Yes	Inside	Yes	55°–85°	40°–70°	70°	55°	2000 ohm.	eYCc & cYBc
cYDb 329	Two-Temp.	Yes	Outside	Yes	Cool-Warm	40°–70°	70°	55°	750 ohm.	" " "
°cYDb 330	Two-Temp.	Yes	Inside	Yes	Cool-Warm	40°–70°	70°	55°	750 ohm.	Compensated
cYDb 331	Two-Temp.	Yes	Concealed Shift Outside	Yes	Cool-Warm	40°–70°	70°	55°	2000 ohm.	Control
°cYDb 332	Two-Temp.	Yes	Inside	Yes	Cool-Warm	40°–70°	70°	55°	2000 ohm.	"
cYDb 333	Two-Temp.	Yes	Concealed Shift Outside	Yes	55°–85°	40°–70°	70°	55°	2000 ohm.	Reversible
°cYDb 334	Two-Temp.	Yes	Inside Concealed Shift	Yes	55°–85°	40°–70°	70°	55°	2000 ohm.	aYCg & cYBf
										" " "
										Reversible
										eYCc & cYBc
										" " "
										Compensated
										Control
										"

VARITHERM

Duct Type

Uses: A special instrument for use in the "Compensated Control" system to actuate a heater on the Heater Thermostat.

Construction: Made in Duct and Surface types. Both types consist of bimetal element, one contact, and a stop. Friction coupling is used so that contact will be made or broken on a *change* in temperature rather than at a chosen temperature point. Acts as a single-pole single-throw switch with a stop to limit motion away from contact. Two coded binding posts. Duct type is threaded for mounting same as Duct Thermostat. Surface type is to be fastened to radiator.

Surface Type

Dimensions: Duct type: Case: 2¾" diameter, 1⅝" deep. Element: 4" long. Surface type: 6⅜" long, 1⅝" wide, 1" deep.

Part No.	Adj.	Maximum Temp.	Diff.	Use	Element Guard	Guard Length	Inserted Length	Remarks
rYDj 273	None	250 F	5°	Air	None	....	3"	Single Circuit
rYDj 274	None	250 F	5°	Air	Perforated	4"	3"	Single Circuit
rYDj 275	None	250 F	5°	Liquid	Closed	4"	3"	Single Circuit
rYDj 281	None	250 F	5°	Air	None	..	3"	Includes rheostat bYZr 6
rYDj 282	None	250 F	5°	Air	Perforated	4"	3"	Includes rheostat bYZr 6
rYDj 283	None	250 F	5°	Liquid	Closed	4"	3"	Includes rheostat bYZr 6
sYDp 276	None	250 F	5°	Fastened to radiator	.....	..	..	Single Circuit
sYDp 277	None	250 F	5°	Fastened to radiator	.....	..	..	Includes rheostat bYZr 6

° Lock Cover Screws—require special wrench YDa 41-2.

Description
Temperature-Sensitive Instruments for Controlling Motor-Operated Valves, Damper Control Motors, Relays, Etc.

DUPLEX THERMOSTAT

Uses: Same as Room Thermostat, but provides a means for automatic control (at the same or different temperatures) of two separate units of heating or cooling equipment from one instrument. Can be used, with external switching means, for two-temperature control of one unit.

Construction: Two complete Room Thermostat mechanisms on one base, under one cover, each with independent setting lever and scale and limiting adjustment. Two sets of three coded binding posts under base. Bakelite base, bakelite ventilated cover with thermometer. Four screw holes in base for mounting.

See also Room Thermostat, Two-Temperature Thermostat, and Heater Thermostat for related types.

Dimensions: 3¾" wide, 6⅜" high, 1⅞" deep.

Part No.	Thermometer	Adjustment	Detent	Scale		Differential	Calibrated at	
				Day	Nite		Day	Nite
*cYDb 258	Yes	Outside	Yes	55°–85°	40°–70°	2°	70°	55°
cYDb 259	Yes	Outside	No	55°–85°	40°–70°	1½°	70°	55°
cYDb 260	Yes	Outside	Yes	55°–85°	40°–70°	2°	70°	55°
°cYDb 261	Yes	Inside	No	55°–85°	40°–70°	1½°	70°	55°
°cYDb 262	Yes	Inside	Yes	55°–85°	40°–70°	2°	70°	55°
				Summer	Winter		Summer	Winter
cYDb 269	Yes	Outside	No	70°–100°	55°–85°	1½°	85°	70°
cYDb 270	Yes	Outside	Yes	70°–100°	55°–85°	2°	85°	70°

TWO-TEMPERATURE THERMOSTAT

Uses: For double-range control in rooms, office buildings, schools, and other enclosed spaces requiring temperature maintained at usual room temperature in the daytime or for a certain period, and at another temperature the rest of the time.

Construction: Same as Duplex Thermostat, except that case contains a magnet operated change-over switch to put the control on one or the other of the two units selectively. Change-over switch may be operated from central control station in building by momentarily energizing one of two electromagnets, or may be shifted at any time by hand, putting the desired unit in the control circuit. One set of three coded binding posts under base, also binding posts for shifting magnets. Four screw holes in base for mounting. Two setting scales inscribed "NITE" and "DAY". See also Room Thermostat, Duplex Thermostat, and Heater Thermostat for related types.

Dimensions: 3¾" wide, 6⅜" high, 1⅞" deep.

Part No.	Thermometer	Adjustment	Detent	Scale		Differential	Calibrated at	
				Day	Nite		Day	Nite
cYDb 325	Yes	Outside	No	55°–85°	40°–70°	1½°	70°	55°
cYDb 326	Yes	Outside	Yes	55°–85°	40°–70°	2°	70°	55°
°cYDb 327	Yes	Inside with Concealed Shift	No	55°–85°	40°–70°	1½°	70°	55°
°cYDb 328	Yes	Inside with Concealed Shift	Yes	55°–85°	40°–70°	2°	70°	55°
*cYDb 335	Yes	Outside	Yes	55°–85°	40°–70°	2°	70°	55°

SURFACE THERMOSTAT

Uses: For pipes, tanks, etc. The Thermostat is to be strapped or clamped in contact with the outside surface.

Construction: Single unit, consisting of disc element, tongue, contacts, and adjusting means. No thermometer. Black reinforced bakelite base and cover. Copper heat-collecting disc on bottom is connected to bimetal disc through copper stud, providing rapid response to temperature changes. Spring yield device prevents strain on tongue from extreme temperature variations. Three coded binding posts on top of case.

Dimensions: Case: 2¾" diameter, 2¼" deep. Overall height: 4⅛".

Part No.	Adjustment	Detent	Scale	Differential	Calibrated at
aYDp 191	Outside	No	100°—200°	10°	150°
aYDp 192	Outside	Yes	100°—200°	10°	150°
aYDp 193	Outside	No	100°—200°	4°	150°
aYDp 194	Outside	Yes	100°—200°	4°	150°

* For 115 V., all others for 25 V.

° Lock Cover Screws—require special wrench YDa 41-2.

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Description

Temperature-Sensitive Instruments for Controlling Motor-Operated Valves, Damper Control Motors, Relays, Etc.

IMMERSION THERMOSTAT

Uses: For pipes, tanks, etc., containing liquids. The sensitive element of the Thermostat is contained in a tube which is to be immersed in the liquid.

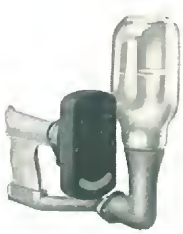
Construction: Identical with standard Duct Thermostat, except that the element guard is a closed tube. A phosphor bronze split sleeve attached to the element contacts the inside of the guard tube to improve the heat transfer. For more rapid heat transfer and response, the tube is partially filled with mercury and suitably sealed (material of some parts is changed, to avoid attack by the mercury). Mercury Filled type, with addition of wick and moistener on element guard, used to control wet-bulb temperature and called a Wet-Bulb Thermostat. Spring yield device prevents strain on tongue from extreme temperature variations. Mounted by screwing into pipe fitting, threaded hole, or flange (¾" pipe thread).

See Duct Thermostat and Furnace Thermostat for related types.

Dimensions: Case: 2⅝" wide, 5" high, 1¼" deep, ½" clearance at back. Element, with guard: ⅞" diameter; length according to range.

Part No.	Adj.	Detent	Scale	Diff.	Cal. At	Element Guard	Guard Length	Inserted Length	Use	Remarks
fYDj 110	Outside	No	90°—210°	3°	150°	Closed	4"	3"	Liquid	
fYDj 111	Outside	Yes	90°—210°	3°	150°	Closed	4"	3"	Liquid	
fYDj 112	Outside	No	90°—210°	3°	150°	Closed	6"	5"	Liquid	
fYDj 113	Outside	Yes	90°—210°	3°	150°	Closed	6"	5"	Liquid	
fYDj 114	Outside	No	70°—190°	3°	130°	Closed	4"	3"	Liquid	
fYDj 115	Outside	Yes	70°—190°	3°	130°	Closed	4"	3"	Liquid	
fYDj 143	Outside	No	230°—390°	3°	310°	Closed	4"	3"	Liquid	
fYDj 144	Outside	Yes	230°—390°	3°	310°	Closed	4"	3"	Liquid	
fYDj 145	Outside	No	230°—390°	20°	310°	Closed	4"	3"	Liquid	High Heat
fYDj 146	Outside	Yes	230°—390°	20°	310°	Closed	4"	3"	Liquid	High Heat
fYDj 149	Outside	No	130°—290°	3°	210°	Closed	4"	3"	Liquid	High Heat
fYDj 150	Outside	Yes	130°—290°	3°	210°	Closed	4"	3"	Liquid	High Heat
fYDj 153	Outside	No	90°—210°	3°	150°	Closed	4"	3"	Liquid	Mercury filled. For mounting on horizontal surface.
fYDj 154	Outside	Yes	90°—210°	3°	150°	Closed	4"	3"	Liquid	Mercury filled. For mounting on horizontal surface.
fYDj 155	Outside	No	90°—210°	3°	150°	Closed	6"	5"	Liquid	Same as fYDj 153 but for mounting on vertical surface.
fYDj 156	Outside	Yes	90°—210°	3°	150°	Closed	6"	5"	Liquid	Same as fYDj 154 but for mounting on vertical surface.
fYDj 167	Outside	No	35°— 75°	2°	55°	Closed	6"	5"	Liquid	Mercury filled. May be used for Wet-Bulb Thermostat. For mounting on vertical surface.
fYDj 168	Outside	Yes	35°— 75°	2°	55°	Closed	6"	5"	Liquid	Mercury filled. May be used for Wet-Bulb Thermostat. For mounting on vertical surface.

WET-BULB THERMOSTAT



Uses: For controlling wet-bulb temperatures in ducts, chambers, or passages.

Construction: A standard Mercury Filled Thermostat for mounting on a vertical surface (see Immersion Thermostat) is used with the bottle, bracket, and felt wick illustrated. The thermostat tube is inserted into the duct or chamber and kept wet with water supplied from the bottle to the wick which is slipped over the end of the thermostat tube. The bottle being on the outside of the duct is easily refilled with water.

Part No.	Description
aYDj 33	Thermostat Mounting Bracket
aYDj 43–1	Bottle Holder
aYDj 226–1	Wick
aYDj 229–1	Bottle
fYDj 167 or 168	Mercury Filled Thermostat to be used with above. See Immersion Thermostat

FURNACE THERMOSTAT

Uses: For bonnet of warm air furnace. May be used as operating control or as limit safety switch.

Construction: Same as Duct Thermostat, except bimetal element is shorter and placed on end of extension tube (without guard) to bring it well into warm air chamber. Swiveling flange mounting holds instrument at desired angle.

Dimensions: Case: Same as Duct Thermostat. Element projection: 9½".

Part No.	Adjustment	Detent	Scale	Differential	Cal. At	Element Guard	Inserted Length
fYDj 151	Outside	No	100°—400°	60°	250°	None	10"
fYDj 152	Outside	Yes	100°—400°	60°	250°	None	10"

Description
Temperature-Sensitive Instruments for Controlling Motor-Operated Valves, Damper Control Motors, Relays, Etc.

DUCT THERMOSTAT

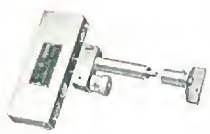
Uses: For ducts, chambers, or other closed passages or containers for air, vapor, or gas. Thermostat is inserted through wall of chamber or passage.

Construction: Single unit, consisting of helical bimetal element, tongue, contacts, adjusting means, and detents (when specified). No thermometer. Element projects into chamber, with perforated guard. Mechanism is in heat-resistant bakelite case on outside. Three coded binding posts outside case. Spring yield device on tongue prevents strain from extreme temperature variations. On Rust-Resistant type, all exposed parts, except bimetal element, are made of bronze and a baffle plate prevents escape of vapor into the case. Mounted by screwing into threaded hole (¾″ pipe thread) or flange. See Immersion Thermostat and Furnace Thermostat for related types.

Dimensions: Case: 2⅝″ wide, 5″ high, 1¼″ deep, ½″ clearance at back. Element with guard: ⅞″ diameter; length, according to range.

Part No.	Adjustment	Detent	Scale	Diff.	Cal. At	Element Guard	Guard Length	Inserted Length	Use
fYDj 100	Outside	No	40°—160°	3°	100°	Perforated	4″	3″	Air
fYDj 101	Outside	Yes	40°—160°	3°	100°	Perforated	4″	3″	Air
fYDj 102	Outside	No	Locked	3°	35°	Perforated	4″	3″	Fresh Air Duct
fYDj 103	Outside	Yes	Locked	3°	35°	Perforated	4″	3″	Fresh Air Duct
fYDj 104	Outside	No	50°— 90°	2°	70°	Perforated	4 9/16″	3 9/16″	Air
fYDj 105	Outside	Yes	50°— 90°	2°	70°	Perforated	4 9/16″	3 9/16″	Air
fYDj 141	Outside	No	230°—390°	3°	310°	None	. .	3″	Air Ducts
fYDj 142	Outside	Yes	230°—390°	3°	310°	None	. .	3″	Air Ducts
†fYDj 157	Outside	No	90°—210°	3°	150°	Perforated	6″	3″	Vapor
†fYDj 158	Outside	Yes	90°—210°	3°	150°	Perforated	6″	3″	Vapor
†fYDj 161	Outside	No	40°—160°	3°	100°	Perforated	6″	3″	Vapor
†fYDj 162	Outside	Yes	40°—160°	3°	100°	Perforated	6″	3″	Vapor
†fYDj 163	Outside	No	35°— 75°	2°	55°	Perforated	6″	3″	Vapor
†fYDj 164	Outside	Yes	35°— 75°	2°	55°	Perforated	6″	3″	Vapor
†fYDj 169	Outside	No	45°— 85°	2°	65°	Perforated	10″	9″	Fruit Storage
†fYDj 170	Outside	Yes	45°— 85°	2°	65°	Perforated	10″	9″	Fruit Storage

AIR STREAM THERMOSTAT



Uses: In unit ventilators or duct systems for heating or cooling. Has long tubular element which extends across entire width of air stream hand responds to *average* temperature.Often used as a pilot to prevent temperature of air dropping below a certain minimum.

Construction: Single unit, consisting of tubular element, tongue, contacts, and adjusting means (on adjustable type). No thermometer. Temperature-sensitive element consists of ½″ aluminum tube enclosing ¼″ invar rod, the two being fastened together at one end. Sheet-metal case containing contact points is attached to other end of invar rod. Movement of free end of aluminum tube moves tongue through spring yield device which prevents strain from extreme temperature variations. Three coded binding posts outside case. aYDr 213 or aYDr 214 is mounted by bracket on duct, aYDr 210 or aYDr 211 is laid on top of coil. Element has rapid response due to large surface and free circulation. Available any length from 20″ (overall) up.

Dimensions: Case: 4⅜″ long, 1¾″ wide, ⅞″ deep. Element: ½″ diameter, length as required.

Part No.	Adjustment	Scale	Differential	Calibrated At	Overall Length
aYDr 210	External	30°—110°	6°	70°	20½″
aYDr 211	None	. . . . .	6°	70°	20½″
aYDr 213	External	30°—110°	6°	70°	20½″
aYDr 214	External	30°—110°	6°	70°	30″

† Rust Resistant.

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Description

Temperature-Sensitive Instruments for Controlling Motor-Operated Valves, Damper Control Motors, Relays, Etc.

MICROTHERM

Microtherm, and associated controls, produces a truly proportioning type of modulating control.

Uses: For accurate control of throttling or proportioning valves or dampers, greatly reducing any possibility of overrun. For control of a device which causes a high rate of change in temperature and which is to be controlled from a point where the circulation, and therefore response of the thermostat, is relatively slow; e.g., Unit Ventilator controlled from a room type thermostat; chilled water supply controlled from an immersion, or room type thermostat; reheater coil controlled from a room type, or duct type thermostat installed in the return air duct. For control of a series of compressors, preventing unnecessary starting and stopping due to hunting. Microtherm can be used only in combination with other Micro Controls—Microvalve, Microtrol, or Micro Program Switch.

NOTE: Because of their design, Micro Controls have no advantage in the control of Positive Valves or Damper Control Motors; Barber-Colman Compensated Control gives the best results for control of this type of equipment.

Construction: Room Type: Consists of a flat bimetal element, contact points, adjusting means, and a solenoid. Black bakelite base and ventilated cover with dial thermometer. Four coded binding posts under base. Two screws under chromium band for mounting.

Duct Type: Similar to Room type, except the temperature-sensitive element is extended and protected by a perforated guard.

Immersion Type: Identical to Duct type, except the element is protected by a closed tube guard. Tube is partially filled with mercury to insure rapid heat transfer.

Each shipment of a Microtherm will include a cYZr 936 spark eliminator.

Standard Element: To be used with a Microvalve for *heating* applications, or with a Microtrol mounted so that the full heating position is at the end of the CCW stroke.

Reversed Element: To be used with a Microvalve for *cooling* applications, or with a Microtrol mounted so that the full cooling position is at the end of the CCW stroke.

Dimensions: Room Type: 3 13/16" wide, 4 9/16" high, 1 13/16" deep. **Duct and Immersion Type:** Case—4 13/16" wide, 5 1/8" high, 1 5/8" deep, 1 1/8" clearance at back. Element, with guard: 7/8" diameter; length according to range.

Part No.	Type	Thermometer	Adjustment	Scale	Differential	Calibrated	Guard Length	Element
bYDt 121	Room	Yes	Outside	50°–90°	1°	70°	None	Std.
bYDt 122	Room	Yes	Outside	90°–50°	1°	70°	None	Rev.
bYDt 123	Room, Two Temp. with Heater	Yes	Outside	40°–80° 50°–90°	1°	60°–70°	None	Std.
bYDt 124	Room, Control Point with Heater	Yes	Outside	90°–50°	1°	70° (Set at 85°)	None	Rev.
cYDt 125	Duct	No	Outside	50°–90°	1°	70°	4"	Std.
cYDt 126	Duct	No	Outside	90°–50°	1°	70°	4"	Rev.
cYDt 127	Duct	No	Outside	40°–160°	1°	100°	4"	Std.
cYDt 128	Immersion, Mercury filled	No	Outside	35°–75°	1°	55°	6"	Std.
cYDt 129	Immersion, Mercury filled	No	Outside	75°–35°	1°	55°	6"	Rev.
cYDt 130	Immersion, Mercury filled	No	Outside	90°–210°	1°	150°	6"	Std.

NOTE:—All types of Microtherms must be mounted on a vertical surface.

THERMOSTATIC ADJUSTER

Uses: For shifting the control point of a thermostat or system in response to a change in some other temperature, usually outdoor temperature.

Potentiometer Type: Provides a means for automatic control of an air conditioning system so that the indoor temperature in summer will vary gradually, in accordance with changes in outdoor temperature, to maintain the most comfortable, healthful and economical conditions. One Thermostatic Adjuster can change the control point of as many as eight thermostats. Note—only Room type Control Point Thermostats can be used with the Potentiometer type Thermostatic Adjuster.

Switch Type: Provides a means for the automatic selection of a different circuit for different temperature ranges; as many as 21 circuits are available. As an example, used in the selection of different timing periods of a Cycler System to regulate the length of time a zone valve can be open for corresponding outdoor temperature ranges.

Construction: Potentiometer Type: Consists of an extended bimetal element, tongue, contacts, and adjusting means similar to Duct type Thermostat. A reversible motor shifts the contact points and the arm of a potential dividing rheostat in response to temperature changes of the bimetal element. A change in outside temperature of 27 F moves the rheostat arm from one limit to the other. This 27-degree operating range may be shifted, by means of an adjusting lever which indicates the high limit of the operating range.

Switch Type: Similar to above except a 21-point switch is used in place of the rheostat. Each point on the switch represents a 5-degree change in outdoor temperature. The adjusting lever indicates the high limit of this 100-degree range.

Dimensions: Case, 12 3/8" wide, 6 1/2" high, 6 5/8" deep, 1/2" clearance at back.

Element with Guard: 7/8" diameter, 6" or 24" long.

Part Number	Motor	Tube	Range of Adjustment	Operating Range	Type
aYDs 117	25 V, 60 Cy.	6"	80 F to 120 F	27°	Potentiometer
aYDs 118	25 V, 60 Cy.	24"	80 F to 120 F	27°	Potentiometer
bYDs 119	25 V, 60 Cy.	6"	−20 F to 80 F	100°	21-Point Switch
bYDs 120	25 V, 60 Cy.	24"	−20 F to 80 F	100°	21-Point Switch

CONTROL POINT THERMOSTAT

Uses: For automatically shifting the control point in accordance with outdoor temperature changes. Can only be used with Potentiometer type Thermostatic Adjuster. As many as eight Control Point Thermostats, can be controlled by one Thermostatic Adjuster. Particularly adapted to the control of cooling systems so that indoor temperatures may be varied automatically in proportion to outdoor temperature changes.

Construction: Similar to Heater Thermostat, except no thermometer. Control point is shifted gradually over a maximum of 12 degrees as outdoor temperatures vary over a range of 27 degrees.

The adjusting lever indicates the control point desired with maximum outdoor temperature.

Dimensions: 2 1/8" wide, 5 3/8" high, 1 3/4" deep.

Part Number	Detent	Operating Range	Calibration
YDa 248-1	No	12°	85°
YDa 249-1	Yes	12°	85°

Barber-Colman control equipment is listed as standard by the Underwriters' Laboratories.

Disc	Sizes	Type
Composition	½", ¾", 1", 1¼", 1½", 2"	Packless, Single Seat, Pos. & Rev.

GENERAL DESCRIPTION

Packless valve, angle pattern with radiator ends. Illustration across page shows disassembly of same valve.

Patterns: ½" to 2", angle right hand, left hand, straightway patterns with radiator ends (union and nipple); 1¼" and 1½" only, globe pattern, screwed ends. (On ½" to 2" sizes, angle pattern furnished unless otherwise specified on order.)

Materials: Brass body and trim.

Finish: Nickel plate, polished hexes. Positive motor-operator has bakelite or zinc alloy cover; reversing operator has zinc alloy case. All exposed steel parts zinc-cadmium plated.

Disc: Renewable composition, steam type standard. Special disc for various fluids. Throttling nuts additional on special order.

Seat: Brass.

Packing: Metal bellows (see drawing).

Motor-Operator: Positive type for shut-off service. Reversing type for regulating (throttling) and shut-off. Detachable as a unit.

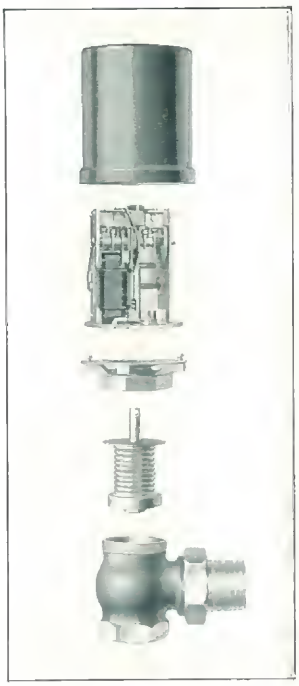
Operation: Positive Type cYBa and YBa: Unidirectional Barcol shaded pole induction motor drives plunger cam by reduction gearing (see drawing). Cam raises and lowers plunger by two-roller follower, opening and closing valve. Pressure of disc on seat when closed imposed by spring in plunger yoke assembly. Automatic cam-operated switches govern accurate stopping at ends of stroke. Auxiliary switches relay indication of position to successive apparatus. Motor-operator stops at open and closed positions.

Operation: Throttling Type cYBf: Same general method, except *reversible* type motor. Motor unit enclosed in oil-filled die cast metal case. External speed adjustment provided. Motor-operator will stop and hold valve at any intermediate position, opening or closing further as required.

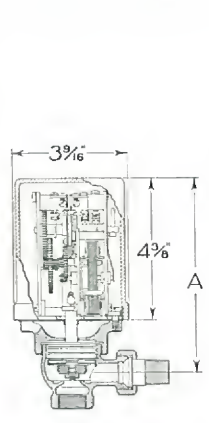
Control: Three wire low-voltage thermostat, single-pole double-throw switch, or equivalent.

Installation: Will operate properly in any position. Unit Heater type can be operated in vertical position only.

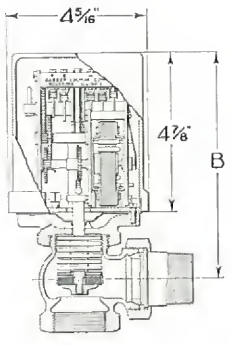
Power Requirements: 25 volt, 60 cycle, AC. Motor-operators for other voltages and frequencies on special order. Change in rated voltage does not alter characteristics of operator. Change in rated frequency alters speed in relation of new frequency to 60 cycles per second, but not in direct ratio. Units for 25 cycle service have approximately ¼ the no-load speed of 60 cycle units.



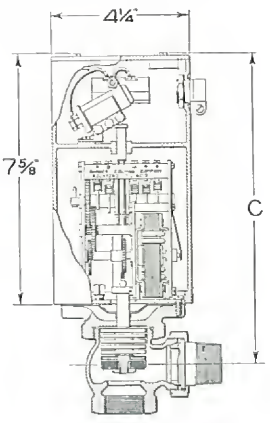
DIMENSIONS



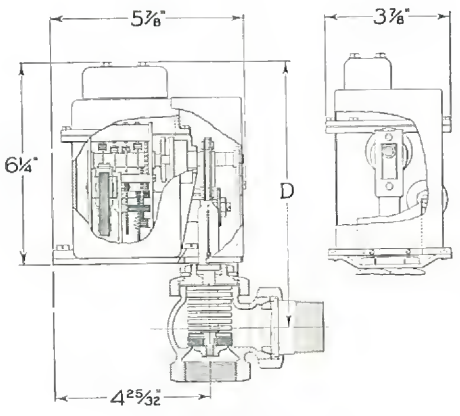
cYBA OPERATOR



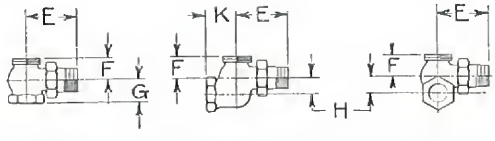
YBA OPERATOR



YBA OPERATOR
UNIT HEATER TYPE

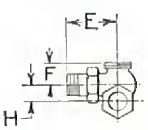


cYBF OPERATOR

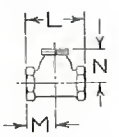


ANGLE STRAIGHTWAY RIGHT HAND

NOM. SIZE	A	B	C	D	E	F	G	H	K	L	M	N
½	6.00	6.50	9.25	7.85	3.00	.94	1.12	.62	1.37			
¾	6.00	6.50	9.25	7.85	2.87	.94	1.19	.75	1.62			
1		6.69	9.44	8.04	3.00	1.12	1.50	1.00	1.87			
1¼		6.88	9.63	8.23	3.50	1.31	1.62	1.12	2.06	4.12	2.06	2.44
1½		7.26	10.00	8.60	3.75	1.69	1.87	1.25	2.31	4.62	2.31	2.94
2		7.69	10.43	9.04	4.37	2.12	2.25	1.50	2.69			



LEFT HAND



GLOBE

Motor-Operated Valves

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Type	Sizes	Disc
Packless, Single Seat, Pos. & Rev.	½", ¾", 1", 1¼", 1½", 2"	Composition

Uses: Packless (metal bellows) valves are for all kinds of low pressure (up to 10 lbs.) service.

The radiator types are used primarily on steam radiators of direct radiation heating systems, which are usually low pressure installations. They can also be used on low pressure steam coils in small indirect radiation heating systems, and on processing units such as automatic autoclaves, kettles, steam tables, steam cabinets, etc. Small valves of this type are widely used on various types of unit ventilators and other cabinet type heaters. They are also useful on automatic humidifiers and air conditioning cabinets where control of low pressure steam is needed.

With the substitution of a special cover in which a high-voltage mercury tube switch is incorporated, a positive valve of this type may be used on a unit heater for multiple operation of supply valve and fan. The mercury tube switch is operated by an extension of the valve plunger and acts as a relay to turn on the fan of the unit heater when the valve opens.

All these packless valves, with special discs, can be used on gas, air, etc., as long as the pressure does not exceed 10 lbs. per sq. in., which is the rated limit of the bellows packing member.

Microvalve: All reversing operators can be ordered as Microvalves by adding the suffix M to the part number. For example, cYBf 350-M.

If the Microvalve is to be used in a reversing series combination with other Micro units, add the suffix R. For example, cYBf 354-MR. Note: Valve Operator must be selected with auxiliary switches arranged for reversing series.

SPECIFICATIONS

Item	Size, In.	Type	Material		Pressure, Lbs./Sq. In.		Approx. Lift, In.	Service	Motor Type	Input				Shading Coil Current Amps.	Average Sec./Stroke	Std. Operator Part No.
			Body	Trim	Static	Diff.				Running		Idle				
										Amps.	Watts	Amps.	Watts			
1	½	Packless	Brass	Brass	10	10	3/16	S	Pos.	2.2	27.5	.....	.....	.....	5	cYBa 490
2	¾	Packless	Brass	Brass	10	10	7/32	S	Pos.	2.2	27.5	.....	.....	.....	5	cYBa 492
3	1	Packless	Brass	Brass	10	10	9/32	S	Pos.	2.0	25	.....	.....	.....	4	YBa 408
4	1¼	Packless	Brass	Brass	10	10	11/32	S	Pos.	2.0	25	.....	.....	.....	4	YBa 412
5	1½	Packless	Brass	Brass	10	10	7/16	S	Pos.	2.0	25	.....	.....	.....	10	YBa 416
6	2	Packless	Brass	Brass	10	10	9/16	S	Pos.	2.0	25	.....	.....	.....	10	YBa 418
8	¾	Packless	Brass	Brass	10	10	7/32	S & R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 350
9	1	Packless	Brass	Brass	10	10	7/32	S & R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 350
10	1¼	Packless	Brass	Brass	10	10	11/32	S & R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 351
11	1½	Packless	Brass	Brass	10	10	7/16	S & R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 352
12	2	Packless	Brass	Brass	10	10	9/16	S & R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 353

EXPLANATION OF TABLE

Item: This number is for cross-reference to other data lists.

Size: Nominal pipe size.

Type: Brief description for general classification.

Material: "Trim" includes seat, disc holder, and stem.

Pressure: Static pressure applies to valve body; differential pressure is that against which valve will close tightly.

Approx. Lift: Distance disc is raised off seat in open position.

Service: "S" shut-off; "R" regulating (throttling).

Motor Type: Whether positive (unidirectional) or reversible.

Input: Principal electrical data of motor-operator.

NOTE: ANGLE PATTERN VALVES SHIPPED ON ALL ORDERS UNLESS OTHERWISE SPECIFIED.

RETURNED MATERIAL

When material is returned to us under circumstances over which we have no control, there will be a re-stocking charge of not less than 10% of the net selling price.

All shipments of material for repair or replacement must be sent with carrying charges prepaid.

Shading Coil Current: Applies only to reversible motor. Is current which must be carried by thermostat or other control switch used with reversing valve.

Average Sec./Stroke: Time required to run from open to closed, or vice versa. More than one number, as 100-1000, means operator has speed adjustable between 100-1000 sec./stroke.

Std. Operator Part No.: This one furnished unless special requirements make it unsuitable. Large variety of auxiliary switching arrangements available.

The valves described on this data sheet are part of the Barber-Colman Electric System of Temperature and Humidity Control. Other units for which similar information is available include:

Thermostats, all kinds
Hygrostats
Single Seat Packed Valves
Semi-Balanced Packed Valves
Full-Balanced Packed Valves
Throttling Valves
Three-way Valves
Solenoid Valves
Butterfly Valves
Damper Control Motors, Positive or Reversing

BARBER-COLMAN COMPANY
Rockford, Illinois

Barber-Colman control equipment is listed as standard by the Underwriters' Laboratories.

Disc	Sizes	Type
Renewable Composition	¼", ⅜", ½", ¾", 1", 1¼", 1½', 2", 2½", 3"	Packed, Single Seat, Pos. & Rev.

GENERAL DESCRIPTION

Single seat packed valve, globe pattern, screwed ends, with positive YBa motor-operator.

Patterns: Globe and angle, screwed ends (¼" to 3") or flanged ends (¾" to 3"). Radiator, with union nut and nipple, angle only (½" to 2").
Globe pattern furnished unless otherwise specified on order.

Material: Brass body and trim.

Finish: ¼" to 3", dull bronze, ground hexes; YBa operator has bakelite or zinc alloy cover; fYBa operator has zinc alloy base with black metal cover, cYBc operator has steel frame and zinc alloy motor case. All exposed steel parts are zinc cadmium plated.

Disc: Renewable composition, steam type standard. Special discs for gases and liquids. Throttling nuts furnished as standard on reversible steam valves up to 2", additional on others.

Seat: Brass, integral with valve body.

Motor-Operator: Positive type for shut-off service. Reversing type for regulating (throttling) and shut-off. Detachable as a unit. Bearings of motor and first gear reduction on YBa and fYBa operators are oil-impregnated bronze. Plain bronze bearings on motor of cYBc and cYBf operators. Other bearings of hardened steel alloy. All gears are machine cut and heat treated.

Operation: Positive Type motor-operator stops only at open and closed positions.

YBa: Unidirectional Barcol shaded pole induction motor drives plunger cam by reduction gearing (see illustration). Cam raises and lowers plunger by two-roller follower, opening and closing valve. Definite pressure imposed on disc by spring in plunger yoke assembly when valve is in closed position. Automatic cam-operated switches positively govern stopping at ends of stroke. Auxiliary cam-operated switches relay control circuit to successive apparatus.

Single Seat packed valve, globe pattern, screwed ends with reversing cYBc motor-operator.

fYBa: Similar to YBa in construction, appearance and operation, but due to its larger motor and heavier gear train it is considerably more powerful. This operator is particularly adaptable to high pressure valves requiring fast operation.

cYBa: Reduction gearing and motor of this operator is oil-immersed and is used on the larger valves, items 21 and 22. It is larger, more rugged, and operates slower. The principle of operation is the same as operators previously described, but the construction is noticeably different.

Reversing Type oil-immersed motor-operator will stop and hold valve at any intermediate position, opening or closing further as required.

cYBf: Reversing motor unit is enclosed in oil-filled die cast metal case. Externally controlled speed adjustment is provided.

cYBc: This operator is oil-immersed and is used on the larger valves, items 31 and 32. It is larger, more rugged, and operates slower. The principle of operation is the same as operators previously described, but the construction is noticeably different.

Control: Three wire low-voltage thermostat, single-pole double-throw switch, or equivalent. Detent type thermostat must be used with fYBa operator.

Installation: Motor-operated valves may be installed in any position. However, with oil immersed units, it is preferable to make the installtion with the operator above the valve body.
Pressure ratings on valves are for pressure under the disc.

Power Requirements: 25 volt, 60 cycle, AC except as noted in specifications. Motor-operators for other voltages and frequencies on special order. Change in rated voltage does not alter characteristics of operator. Change in rated frequency alters speed in relation of new frequency to 60 cycles per second, but not in direct ratio. Units for 25 cycle service have approximately ⅓ the no-load speed of 60 cycle units.

Single seat packed valve, angle pattern, screwed ends, with reversing cYBf motor-operator.

USES: These valves are suitable for the control of steam, water, gas or oil. For allowable pressures, see specifications.
Positive packed valves are commonly used on hot water heating systems, the radiator type being made especially for this purpose. They are also especially adaptable to the control of central steam systems in residences and commercial buildings. Positive valves are also extensively used in air conditioning or blast systems on heating or cooling coils, air washers, spray nozzles, etc., where shut-off service only is required.

Single seat reversing type valves may be used for some types of throttling service, but for best results the semi-balanced type should be used. See data sheet V-80.

Both the positive and reversing type have many applications in the control of commercial and industrial processes. A few of the many uses include: the control of gas supply lines to heat treating furnaces and lead pots; steam and water supply lines to bottle washers, pasteurizers, and autoclaves; and steam supply lines to water heaters and water storage tanks.

All motor-operated valves may be controlled either automatically by thermostats, hygrostats, relays, time-switches, etc., or by manually operated switches from a remote point.

Single Seat packed valve, angle pattern, screwed ends, with positive fYBa motor-operator.

YBa and fYBa operators are not designed for continuous service or for intermittent service where valve must open and close more than ten times per hour. For continuous operation a special positive oil-immersed operator should be used.

Microvalve: All reversing operators can be ordered as Microvalves by adding the suffix-M to the part number. For example, cYBf 350-M.

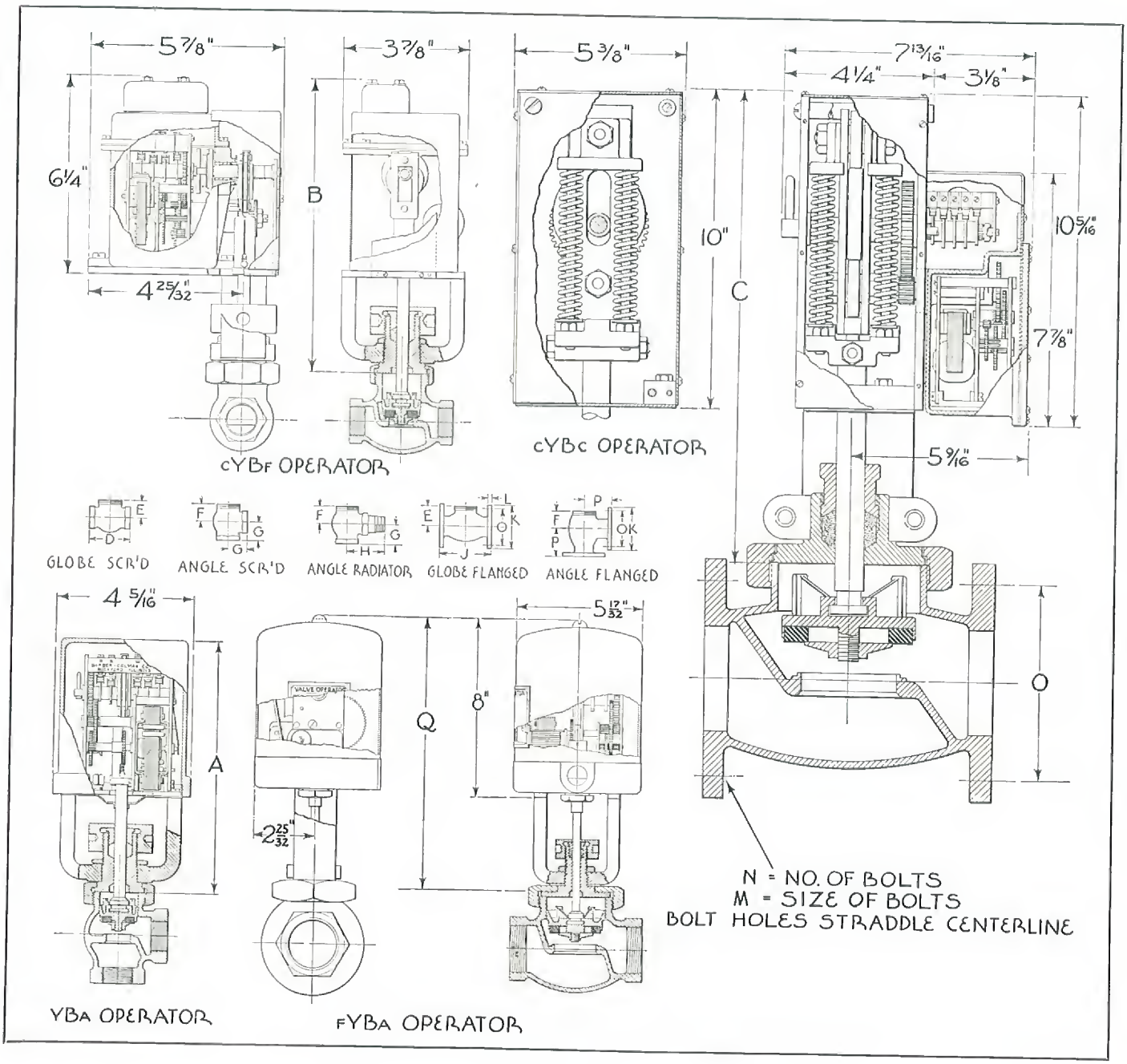
If the Microvalve is to be used in a reversing series combination with other Micro units, add the suffix R. For example, cYBf 354-MR.

Note: Valve Operator must be selected with auxiliary switches arranged for reversing series.

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Type	Sizes	Disc
Packed, Single Seat, Pos. & Rev.	¼", ⅜", ½", ¾", 1", 1¼", 1½", 2", 2½", 3"	Renewable Composition

DIMENSIONS



NOM. SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q
¼	7.91	9.25		2.00	.95	.86	.94									
⅜	7.91	9.25		2.31	1.12	.97	1.06									
½	7.93	9.27		2.68	1.26	1.15	1.25	2.56								
¾	7.93	9.27		3.18	1.49	1.34	1.43	3.00	3.75	3.87	.34	½	4	2.75	2.44	
1	7.99	9.33		3.75	1.72	1.56	1.69	3.50	4.38	4.25	.38	½	4	3.12	2.56	2.31
1¼	8.02	9.36		4.25	2.04	1.86	2.00	4.00	4.81	4.62	.41	½	4	3.50	2.88	2.34
1½	8.10	9.44		4.75	2.29	2.09	2.18	4.38	5.50	5.00	.44	½	4	3.87	3.18	2.42
2	8.13	9.47		5.75	2.77	2.51	2.69	5.25	6.50	6.00	.50	⅝	4	4.75	3.75	2.56
2½			14.75	6.75	3.10	2.93	3.25		7.50	7.00	.56	⅝	4	5.50	4.31	2.59
3			14.75	8.00	3.62	3.43	3.81		8.87	7.50	.62	⅝	4	6.00	4.62	2.73

NOTE: GLOBE PATTERN VALVES SHIPPED ON ALL ORDERS UNLESS OTHERWISE SPECIFIED.

RETURNED MATERIAL

When material is returned to us under circumstances over which we have no control, there will be a re-stocking charge of not less than 10% of the net selling price.

All shipments of material for repair or replacement must be sent with carrying charges prepaid.

Disc	Sizes	Type
Renewable Composition	¼", ⅜", ½", ¾", 1", 1¼", 1½", 2", 2½", 3"	Packed, Single Seat, Pos. & Rev.

SPECIFICATIONS

Item	Size, In.	Type	Material		Pressure, Lbs./Sq. In.		Approx. Lift, In.	Service	Motor Type	Input				Shading Coil Current, Amps.	Average Sec./Stroke	Std. Operator Part No.
										Running		Idle				
			Body	Trim	Static	Diff.				Amps.	Watts	Amps.	Watts			
13	¼	Single Seat	Brass	Brass	150	150	7/32	S	Pos.	2.0	25	.....	.....	.....	20	YBa 422
14	⅜	Single Seat	Brass	Brass	150	150	7/32	S	Pos.	2.0	25	.....	.....	.....	20	YBa 422
15	½	Single Seat	Brass	Brass	150	150	11/32	S	Pos.	2.0	25	.....	.....	.....	20	YBa 424
16	¾	Single Seat	Brass	Brass	150	100	11/32	S	Pos.	2.0	25	.....	.....	.....	20	YBa 424
17	1	Single Seat	Brass	Brass	150	70	11/32	S	Pos.	2.0	25	.....	.....	.....	20	YBa 424
185	1	Single Seat	Brass	Brass	150	150	3/8	S	Pos.	2.2	28	.....	.....	.....	35	fYBa 741
†191	1	Single Seat	Brass	Brass	150	150	3/8	S	Pos.	0.5	28	.....	.....	.....	35	fYBa 742
18	1¼	Single Seat	Brass	Brass	150	40	9/16	S	Pos.	2.0	25	.....	.....	.....	20	YBa 420
186	1¼	Single Seat	Brass	Brass	150	150	5/8	S	Pos.	2.2	28	.....	.....	.....	35	fYBa 743
†192	1¼	Single Seat	Brass	Brass	150	150	5/8	S	Pos.	0.5	28	.....	.....	.....	35	fYBa 744
19	1½	Single Seat	Brass	Brass	150	25	9/16	S	Pos.	2.0	25	.....	.....	.....	20	YBa 420
187	1½	Single Seat	Brass	Brass	150	120	5/8	S	Pos.	2.2	28	.....	.....	.....	35	fYBa 743
†193	1½	Single Seat	Brass	Brass	150	120	5/8	S	Pos.	0.5	28	.....	.....	.....	35	fYBa 744
20	2	Single Seat	Brass	Brass	150	10	9/16	S	Pos.	2.0	25	.....	.....	.....	20	YBa 420
188	2	Single Seat	Brass	Brass	150	70	7/8	S	Pos.	1.8	23	.....	.....	.....	95	fYBa 751
†194	2	Single Seat	Brass	Brass	150	70	7/8	S	Pos.	0.4	23	.....	.....	.....	95	fYBa 752
21	2½	Single Seat	Brass	Brass	150	50	7/8	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 450
189	2½	Single Seat	Brass	Brass	150	45	7/8	S	Pos.	1.8	23	.....	.....	.....	95	fYBa 751
†195	2½	Single Seat	Brass	Brass	150	45	7/8	S	Pos.	0.4	23	.....	.....	.....	95	fYBa 752
22	3	Single Seat	Brass	Brass	150	35	7/8	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 450
190	3	Single Seat	Brass	Brass	150	30	7/8	S	Pos.	1.8	23	.....	.....	.....	95	fYBa 751
†196	3	Single Seat	Brass	Brass	150	30	7/8	S	Pos.	0.4	23	.....	.....	.....	95	fYBa 752
23	¼	Single Seat	Brass	Brass	150	150	7/32	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 350
24	⅜	Single Seat	Brass	Brass	150	150	7/32	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 350
25	½	Single Seat	Brass	Brass	150	150	11/32	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 351
26	¾	Single Seat	Brass	Brass	150	100	11/32	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 351
27	1	Single Seat	Brass	Brass	150	70	11/32	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 351
28	1¼	Single Seat	Brass	Brass	150	40	9/16	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 353
29	1½	Single Seat	Brass	Brass	150	25	9/16	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 353
30	2	Single Seat	Brass	Brass	150	10	9/16	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 353
31	2½	Single Seat	Brass	Brass	150	50	7/8	S&R	Rev.	2.8	35	2.8	22	.50	275	cYBc 460
32	3	Single Seat	Brass	Brass	150	35	7/8	S&R	Rev.	2.8	35	2.8	22	.50	275	cYBc 460

† 115V operators—all others are 25V.

Item: This number is for cross-reference to other data lists.
Size: Nominal pipe size.
Type: Brief description for general classification.
Material: "Trim" includes seat, disc holder, and stem.
Pressure: Static pressure applies to valve body; differential pressure is that against which valve will close tightly.
Approx. Lift: Distance disc is raised off seat in full-open position.
Service: "S" shut-off; "R" regulating (throttling).
Motor Type: Whether positive (unidirectional) or reversible.
Input: Principal electrical data of motor-operator.
Shading Coil Current: Applies only to reversible motor. Is current which must be carried by thermostat or other control switch used with reversing valve.
Average Sec./Stroke: Time required to run from open to closed, and vice versa. More than one number, as 100-1000, means operator has speed adjustment between 100 and 1000 sec./stroke. Type cYBc operators also available with external speed adjustment, both positive and reversing, minimum time (shown) being about 1/10 of maximum.
Std. Operator Part No.: This one furnished unless special requirements make it unsuitable. Large variety of auxiliary switching arrangements available.

The valves described on this data sheet are part of the Barber-Colman Electric System of Temperature and Humidity Control. Other units for which similar information is available include:

Thermostats, all kinds
Hygrostats
Packless Radiator Valves
Semi-Balanced Packed Valves
Full-Balanced Packed Valves
Throttling Valves
Three-way Valves
Solenoid Valves
Butterfly Valves
Damper Control Motors, Positive or Reversing

BARBER-COLMAN COMPANY
Rockford, Illinois

Barber-Colman control equipment is listed as standard by the Underwriters' Laboratories.

Motor-Operated Valves

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Disc	Sizes	Type
Renewable Composition	2″, 2½″, 3″, 3½″, 4″, 5″, 6″	Packed, Single Seat, Pos. & Rev.

Single Seat Packed Valve, Globe Pattern, with Flanged Ends

GENERAL DESCRIPTION

Patterns: Globe and angle, screwed or flanged ends. (Globe pattern furnished unless otherwise specified on order.)

Material: Cast iron body, bronze trim.

Finish: Body and bonnet, black paint; cYBc motor operator, zinc cadmium plated; fYBa motor operator, zinc alloy base with black lacquered metal cover.

Disc: Renewable composition, steam type standard. Special discs for liquids and gases.

Seat: Bronze.

Motor-Operator: Positive type for shut-off service. Reversible type for regulating (throttling or shut-off). Detachable as a unit.

Operation: fYBa (positive type only)—Barcol shaded pole induction motor drives large cam by reduction gearing. Cam raises and lowers plunger by two roller follower, opening and closing valve. Pressure on disc, when closed, applied by spring yield in plunger yoke assembly. Automatic cam-operated switches in motor unit govern accurate stopping at ends of stroke. Auxiliary switches relay indication of position to other apparatus.

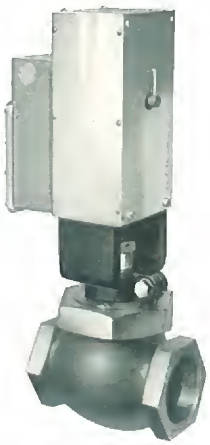
cYBc (positive and reversible)—construction similar to fYBa except motor and gearing enclosed in oil-filled housing, with identical method of operation.

Positive (unidirectional) motor-operator stops only at open and closed positions.

Reversible motor-operator will stop and hold valve at any intermediate position, opening or closing further as required.

Control: Three-wire low-voltage thermostat, single-pole double-throw switch or equivalent.

Installation: Motor-operated valves may be installed in any position. However, with oil-immersed units, it is preferable to make the installation with the operator above the valve body. Pressure ratings on valves are for pressure under the disc.



Single Seat Packed Valve, Globe Pattern, with Screwed Ends

Power Requirements: 25 volt, 60 cycle, AC except as noted in specifications. Motor-operators for other voltages and frequencies on special order. Change in rated voltage does not alter characteristics of operator. Change in rated frequency alters speed in relation of new frequency to 60 cycles per second, but not in direct ratio. Units for 25 cycle service have approximately ¼ the no-load speed of 60 cycle units.

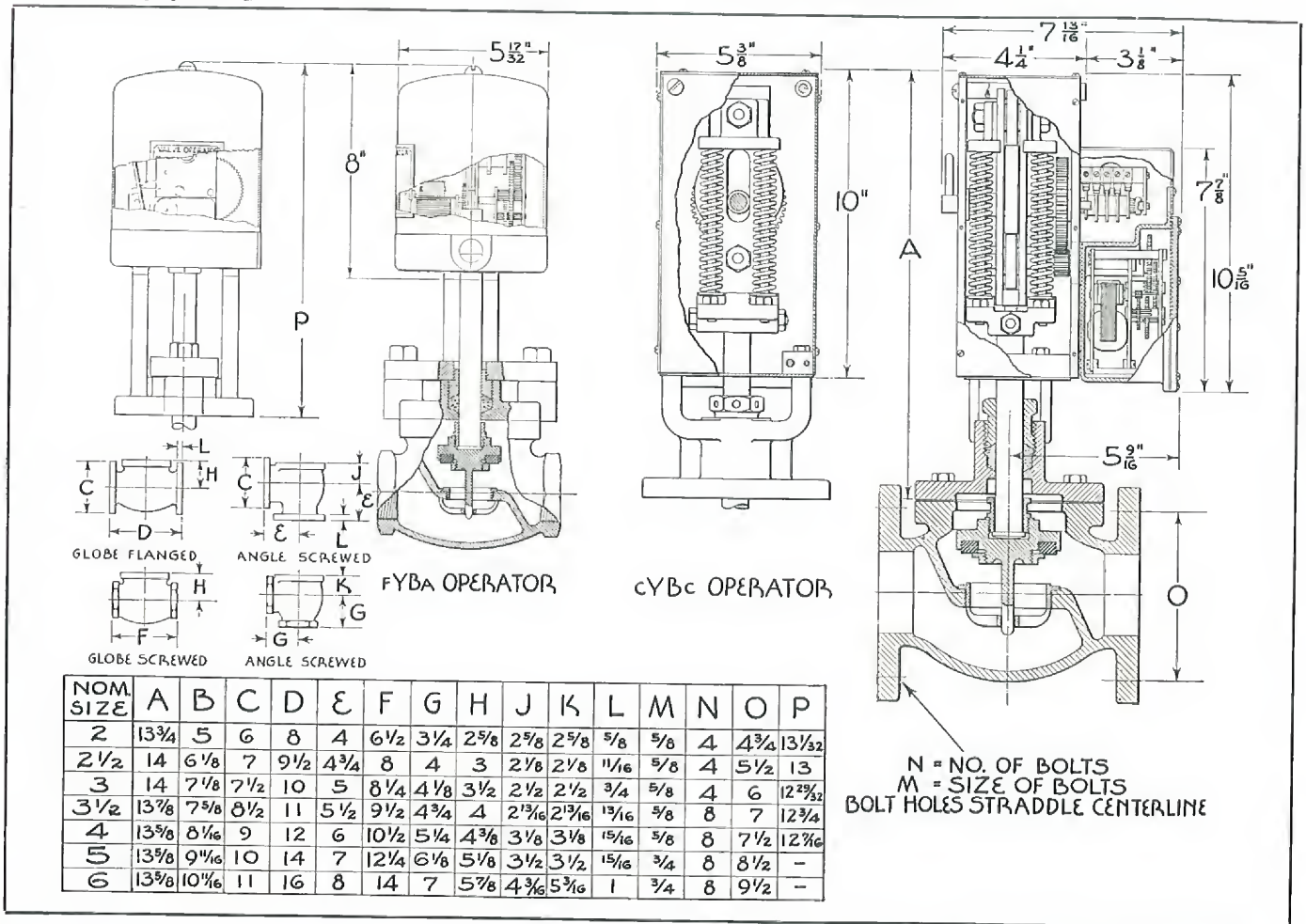
Note: In making applications of fYBa operators on single seat valves, it should be noted that the standard cYBc operators on the cast iron valves, 2″ to 4″ inclusive, have a greater lift than fYBa and therefore give a greater opening. This is sometimes important, especially on liquids or high pressure gases.

The fYBa operator is not an oil-immersed unit. The motor bearings are equipped, however, with wick oilers, thereby assuring lubrication on the highest speed shaft.

Microvalve: All reversing operators can be ordered as Microvalves by adding the suffix -M to the part number. For example, cYBc 474-M.

If the Microvalve is to be used in a reversing series combination with other Micro units, add the suffix R. For example, cYBc 477-MR.

Note: Valve Operator must be selected with auxiliary switches arranged for reversing series.



NOM. SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P
2	13¾	5	6	8	4	6½	3¼	2⅝	2⅝	2⅝	⅝	⅝	4	4¾	13 1/32
2½	14	6⅛	7	9½	4¾	8	4	3	2⅛	2⅛	11/16	⅝	4	5½	13
3	14	7⅛	7½	10	5	8¼	4⅛	3½	2½	2½	¾	⅝	4	6	12 29/32
3½	13⅞	7⅝	8½	11	5½	9½	4¾	4	2 13/16	2 13/16	13/16	⅝	8	7	12¾
4	13⅝	8 1/16	9	12	6	10½	5¼	4⅜	3⅛	3⅛	15/16	⅝	8	7½	12 5/16
5	13⅝	9 11/16	10	14	7	12¼	6⅛	5⅛	3½	3½	15/16	¾	8	8½	–
6	13⅝	10 11/16	11	16	8	14	7	5⅞	4 3/16	5 3/16	1	¾	8	9½	–

Type	Sizes	Disc
Packed, Single Seat, Pos. & Rev.	2", 2½", 3", 3½", 4", 5", 6"	Renewable Composition

Uses: These valves are suitable for the control of steam, water, gas or oil. For allowable pressures, see specifications.

They are especially adaptable to the control of central steam systems in residences and commercial buildings. Positive valves are also extensively used in air conditioning or blast systems on heating or cooling coils, air washers, spray nozzles, etc., where shut-off service only is required.

Single seat reversing type valves may be used for some types of throttling service, but for best results the semi-balanced type should be used. See data sheet V-80.

Both the positive and reversing types have many applications in the control of commercial and industrial processes. A few of the many uses include: the control of gas supply lines to heat treating furnaces and lead pots; steam and water supply lines to bottle washers, pasteurizers, and autoclaves; and steam supply lines to water heaters and water storage tanks.

All motor-operated valves may be controlled either automatically by thermostats, hygrostats, relays, time-switches, etc., or by manually operated switches from a remote point.

The fYBa operator is not designed for continuous service or for intermittent service where valve must open and close more than ten times per hour. For continuous operation an oil-immersed operator should be used.

SPECIFICATIONS

Item	Size, In.	Type	Material		Pressure, Lbs./Sq. In.		Approx. Lift, In.	Service	Motor Type	Input				Shading Coil Current, Amps.	Average Sec./Stroke	Std. Operator Part No.
										Running		Idle				
			Body	Trim	Static	Diff.				Amps.	Watts	Amps.	Watts			
47	2	Single Seat	C.I.	Bronze	125	80	1⅜	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 454
48	2½	Single Seat	C.I.	Bronze	125	50	1⅜	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 454
49	3	Single Seat	C.I.	Bronze	125	35	1⅜	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 454
50	3½	Single Seat	C.I.	Bronze	125	25	1⅜	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 454
51	4	Single Seat	C.I.	Bronze	125	18	1⅜	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 454
52	5	Single Seat	C.I.	Bronze	125	12	1⅜	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 454
53	6	Single Seat	C.I.	Bronze	125	9	1⅜	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 454
54	2	Single Seat	C.I.	Bronze	125	80	1⅜	S	Rev.	2.8	35	2.8	22	.50	275	cYBc 474
55	2½	Single Seat	C.I.	Bronze	125	50	1⅜	S	Rev.	2.8	35	2.8	22	.50	275	cYBc 474
56	3	Single Seat	C.I.	Bronze	125	35	1⅜	S	Rev.	2.8	35	2.8	22	.50	275	cYBc 474
57	3½	Single Seat	C.I.	Bronze	125	25	1⅜	S	Rev.	2.8	35	2.8	22	.50	275	cYBc 474
58	4	Single Seat	C.I.	Bronze	125	18	1⅜	S	Rev.	2.8	35	2.8	22	.50	275	cYBc 474
59	5	Single Seat	C.I.	Bronze	125	12	1⅜	S	Rev.	2.8	35	2.8	22	.50	275	cYBc 474
60	6	Single Seat	C.I.	Bronze	125	9	1⅜	S	Rev.	2.8	35	2.8	22	.50	275	cYBc 474
205	2	Single Seat	C.I.	Bronze	125	70	⅞	S	Pos.	1.8	23	.....	.....	.....	95	fYBa 751
206	2½	Single Seat	C.I.	Bronze	125	45	⅞	S	Pos.	1.8	23	.....	.....	.....	95	fYBa 751
207	3	Single Seat	C.I.	Bronze	125	30	⅞	S	Pos.	1.8	23	.....	.....	.....	95	fYBa 751
208	3½	Single Seat	C.I.	Bronze	125	22	⅞	S	Pos.	1.8	23	.....	.....	.....	95	fYBa 751
209	4	Single Seat	C.I.	Bronze	125	16	⅞	S	Pos.	1.8	23	.....	.....	.....	95	fYBa 751
†210	2	Single Seat	C.I.	Bronze	125	70	⅞	S	Pos.	0.4	23	.....	.....	.....	95	fYBa 752
†211	2½	Single Seat	C.I.	Bronze	125	45	⅞	S	Pos.	0.4	23	.....	.....	.....	95	fYBa 752
†212	3	Single Seat	C.I.	Bronze	125	30	⅞	S	Pos.	0.4	23	.....	.....	.....	95	fYBa 752
†213	3½	Single Seat	C.I.	Bronze	125	22	⅞	S	Pos.	0.4	23	.....	.....	.....	95	fYBa 752
†214	4	Single Seat	C.I.	Bronze	125	16	⅞	S	Pos.	0.4	23	.....	.....	.....	95	fYBa 752

†115V operators—all others 25V.

EXPLANATION OF TABLE

Item: This number is for cross-reference to other data lists.
Size: Nominal pipe size.
Type: Brief description for general classification.
Material: "Trim" includes seat, disc holder, and stem.
Pressure: Static pressure applies to valve body; differential pressure is that against which valve will close tightly.
Approx. Lift: Distance disc is raised off seat in full open position.
Service: "S" shut-off; "R" regulating (throttling).
Motor Type: Whether positive (unidirectional) or reversible.
Input: Principal electrical data of motor-operator.
Shading Coil Current: Applies only to reversible motor. Is current which must be carried by thermostat or other control switch used with reversing valve.
Average Sec./Stroke: Time required to run from open to closed, or vice versa. All cYBc valves shown, both positive and reversing, also available with external speed adjustment. Time shown is minimum for this adjustment. Ratio, minimum to maximum, about 1 to 10.
Std. Operator Part No.: This one furnished unless special requirements make it unsuitable. Large variety of auxiliary switching arrangements available.

NOTE: GLOBE PATTERN VALVES SHIPPED ON ALL ORDERS UNLESS OTHERWISE SPECIFIED.

RETURNED MATERIAL

When material is returned to us under circumstances over which we have no control, there will be a re-stocking charge of not less than 10% of the net selling price.

All shipments of material for repair or replacement must be sent with carrying charges prepaid.

The valves described on this data sheet are part of the Barber-Colman Electric System of Temperature and Humidity Control. Other units for which similar information is available include:

Thermostats, all kinds
Hygrostats
Packless Radiator Valves
Semi-Balanced Packed Valves
Full-Balanced Packed Valves
Throttling Valves
Three-way Valves
Solenoid Valves
Butterfly Valves
Damper Control Motors, Positive or Reversing

BARBER-COLMAN COMPANY
Rockford, Illinois

Barber-Colman control equipment is listed as standard by the Underwriters' Laboratories

Motor-Operated Valves

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Disc	Sizes	Type
Metal or Renewable Composition	½", ¾", 1", 1¼", 1½", 2", 2½", 3", 3½", 4", 5", 6", 8"	Pilot Piston, Single Seat, Pos. Only

GENERAL DESCRIPTION

Patterns: Globe only, screwed or flanged ends.

Material: ½" to 3", bronze body and trim; 3½" to 8", cast iron body with bronze trim.

Finish: ½" to 3", dull bronze, ground hexes; 3½" to 8", black paint. YBa operator has bakelite or zinc alloy cover; fYBa operator has zinc alloy base with black metal cover, cYBc operator in steel case. All exposed steel parts zinc-cadmium plated.

Disc: Metal disc supplied as standard for steam or gas. Composition discs available for water and other liquids on order.

Seat: Bronze.

Motor-Operator: Positive type for shut-off service only.

Operation: Positive Type: Unidirectional Barcol shaded pole induction motor drives plunger cam by reduction gearing (see drawings). Cam raises and lowers plunger by two-roller follower, opening and closing valve. Pressure of disc on seat when closed is imposed by spring in plunger yoke assembly and pressure of fluid on disc. Automatic cam-operated switches govern accurate stopping at ends of stroke. Auxiliary switches relay indication of position to successive apparatus. Positive motor-operator stops only at open and closed positions.

The cYBc operators, used on 3½" to 8" valves are larger, more rugged, and slower than YBa and fYBa—note illustration and specifications. Principles of operation the same, construction noticeably different.

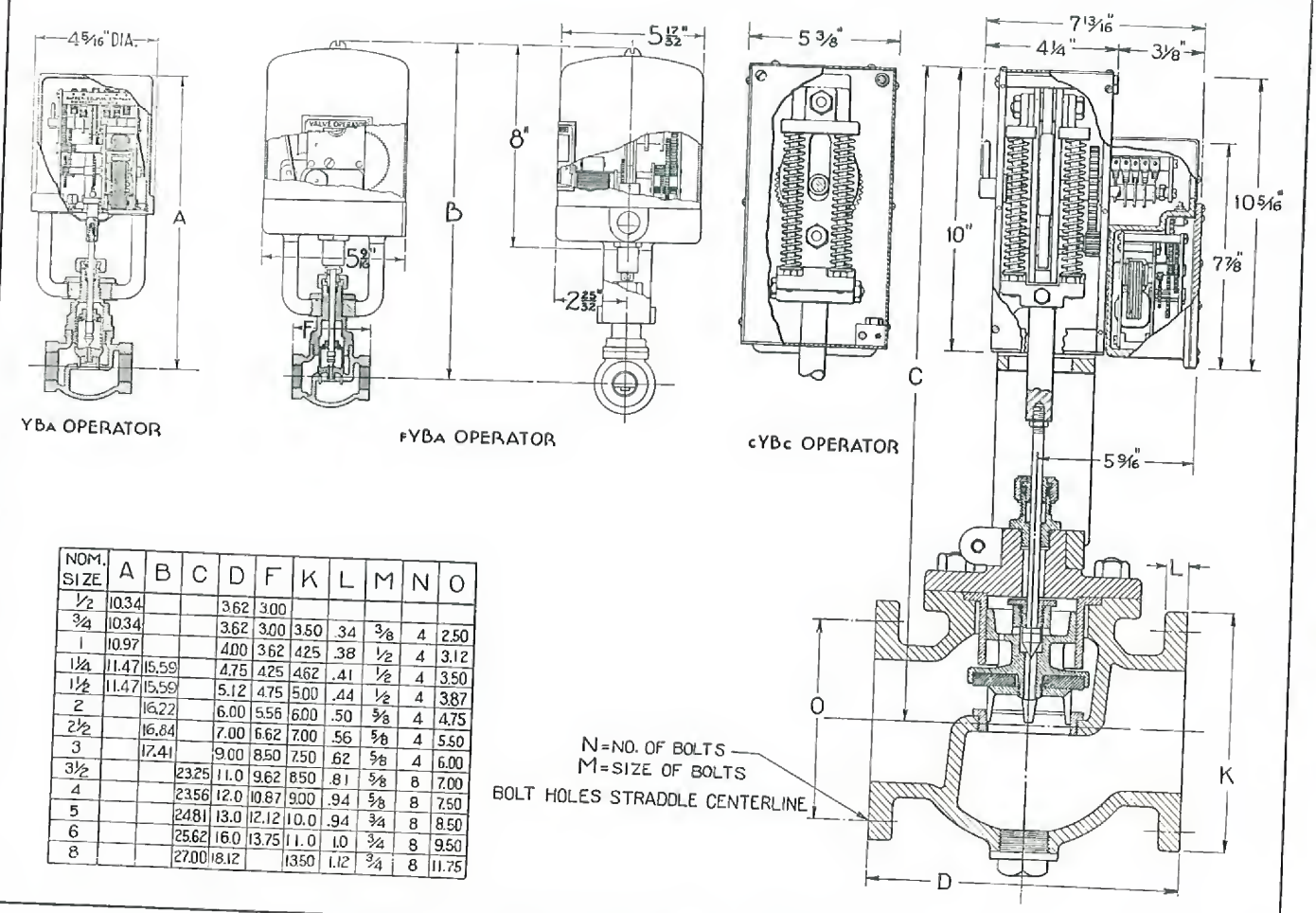
Pilot Piston Type: Disc holder, held on seat by line pressure, is extended into a hollow piston having free sliding fit in cylindrical chamber formed by upper part of valve body. Needle valve point on end of valve plunger opens small hole through disc holder and releases line pressure from upper part of piston when motor-operator starts to open valve, thus producing almost equal low pressures on both top and bottom of piston and disc holder assembly. Needle valve point engages plug collar in top of piston and raises entire balanced assembly. Rapid poppet action occurs as disc leaves seat due to lost motion between needle point and disc assembly being taken up by unbalance of pressures on top of piston and bottom of disc holder. Unbalance quickly removed by flow of fluid through holder and piston to top of chamber, leaving motor-operator to support only weight of piston and holder assembly for balance of stroke. Closing sequence is the reverse, line pressure on top of holder and piston assisting motor-operator to seat disc and hold disc on seat after closing.

Control: Three wire low-voltage thermostat, single-pole double-throw switch, or equivalent. Detent thermostat must be used with fYBa.

Installation: For use in upright position generally. Cannot be inverted when carrying condensing vapors because cylinder will fill with condensate and prevent proper functioning.

Power Requirements: 25 volt, 60 cycle, AC except as noted in specifications. Motor-operators for other voltages and frequencies on special order. Change in rated voltage does not alter characteristics of operator. Change in rated frequency alters speed in relation of new frequency to 60 cycles per second, but not in direct ratio. Units for 25 cycle service have approximately ¼ the no-load speed of 60 cycle units.

DIMENSIONS



NOM. SIZE	A	B	C	D	F	K	L	M	N	O
½	10.34			3.62	3.00					
¾	10.34			3.62	3.00	3.50	.34	3/8	4	2.50
1	10.97			4.00	3.62	4.25	.38	½	4	3.12
1¼	11.47	15.59		4.75	4.25	4.62	.41	½	4	3.50
1½	11.47	15.59		5.12	4.75	5.00	.44	½	4	3.87
2		16.22		6.00	5.56	6.00	.50	5/8	4	4.75
2½		16.84		7.00	6.62	7.00	.56	5/8	4	5.50
3		17.41		9.00	8.50	7.50	.62	5/8	4	6.00
3½			23.25	11.0	9.62	8.50	.81	5/8	8	7.00
4			23.56	12.0	10.87	9.00	.94	5/8	8	7.50
5			24.81	13.0	12.12	10.0	.94	3/4	8	8.50
6			25.62	16.0	13.75	11.0	1.0	3/4	8	9.50
8			27.00	18.12		13.50	1.12	3/4	8	11.75

Type	Sizes	Disc
Pilot Piston. Single Seat, Pos. Only	½", ¾". 1", 1¼", 1½", 2", 2½", 3", 3½", 4", 5", 6", 8"	Metal or Renewable Composition

Uses: Pilot piston valves are single seat packed valves suitable for high pressure work up to the capacity of the valve body. The pilot piston disc construction provides what is to all purposes a balanced valve, with tight shut-off, which the piston or double seat type valve cannot give. It also makes possible a high pressure valve having the same motor-operator as low pressure valves.

Principal uses for this type of valve will be found in those industrial applications where the control of steam, liquids, or gases at pressures up to 150 and (in the smaller sizes) 250 lbs. is called for. There are many instances where process control installations require valves of this kind, such as pressure cookers, high temperature steam jackets, chemical processes, compressed air supply lines, etc.

While space heating with steam as high as 125 and 150 lbs. pressure is relatively rare, it is found to be quite common in textile mills. Pilot piston valves are ideally suited to this type of installation.

It can be generally stated that pilot piston valves can be used on any liquid, vapor, or gas line within the pressure capacity, carrying a fluid not injurious to the valve materials, and where close regulation at minimum flow is not required. Pilot piston valves 3½" and larger are not recommended for use on gases or vapors.

SPECIFICATIONS

Item	Size, In.	Type	Material		Pressure, Lbs./Sq. In.		Lift	Service	Input				Sec. Stroke	Std. Operator Part No.
									Running		Standing			
			Body	Trim	Static	Diff.			Amps.	Watts	Amps.	Watts		
61	½	Pilot Piston	Bronze	Bronze	150	150	11/32	S	2.0	25	.....	.....	20	YBa 424
62	¾	Pilot Piston	Bronze	Bronze	150	150	11/32	S	2.0	25	.....	.....	20	YBa 424
63	1	Pilot Piston	Bronze	Bronze	150	150	11/32	S	2.0	25	.....	.....	20	YBa 424
*64	1¼	Pilot Piston	Bronze	Bronze	150	150	9/16	S	2.0	25	.....	.....	20	YBa 420
245	1¼	Pilot Piston	Bronze	Bronze	150	150	5/8	S	2.2	28	.....	.....	35	fYBa 741
*65	1½	Pilot Piston	Bronze	Bronze	150	150	9/16	S	2.0	25	.....	.....	25	YBa 420
197	1½	Pilot Piston	Bronze	Bronze	150	150	5/8	S	2.2	28	.....	.....	35	fYBa 741
198	2	Pilot Piston	Bronze	Bronze	150	150	5/8	S	2.2	28	.....	.....	35	fYBa 743
199	2½	Pilot Piston	Bronze	Bronze	150	150	7/8	S	2.2	28	.....	.....	35	fYBa 745
200	3	Pilot Piston	Bronze	Bronze	150	150	7/8	S	2.2	28	.....	.....	35	fYBa 745
77	3½	Pilot Piston	C.I.	Bronze	150	150	7/8	S	2.3	30	.....	.....	75	cYBc 450
78	4	Pilot Piston	C.I.	Bronze	150	150	7/8	S	2.3	30	.....	.....	75	cYBc 450
79	5	Pilot Piston	C.I.	Bronze	150	150	1 3/8	S	2.3	30	.....	.....	75	cYBc 454
80	6	Pilot Piston	C.I.	Bronze	150	150	1 3/8	S	2.3	30	.....	.....	75	cYBc 454
81	8	Pilot Piston	C.I.	Bronze	150	150	1 3/8	S	2.3	30	.....	.....	75	cYBc 454
†246	1¼	Pilot Piston	Bronze	Bronze	150	150	5/8	S	0.5	28	.....	.....	35	fYBa 742
†201	1½	Pilot Piston	Bronze	Bronze	150	150	5/8	S	0.5	28	.....	.....	35	fYBa 742
†202	2	Pilot Piston	Bronze	Bronze	150	150	5/8	S	0.5	28	.....	.....	35	fYBa 744
†203	2½	Pilot Piston	Bronze	Bronze	150	150	7/8	S	0.5	28	.....	.....	35	fYBa 746
†204	3	Pilot Piston	Bronze	Bronze	150	150	7/8	S	0.5	28	.....	.....	35	fYBa 746

*Recommended for liquid service only, and will be supplied with renewable composition discs for water unless otherwise specified.

†115V operators—all others are 25V.

Item: This number is for cross-reference to other data lists.
Size: Nominal pipe size.
Type: Brief description for general classification.
Material: "Trim" includes seat, disc, and stem.
Pressure: Static pressure applies to valve body; differential pressure is that against which valve will close tightly.
Approx. Lift: Distance disc is raised off seat in open position.
Service: "S" shut-off.
Input: Principal electrical data of motor-operator.
Average Sec./Stroke: Time required to run from open to closed, or vice versa. Type cYBc operators also available with external speed adjustment, minimum time (shown) being about 1/10 of maximum.
Std. Operator Part No.: This one furnished unless special requirements make it unsuitable. Large variety of auxiliary switching arrangements available.

RETURNED MATERIAL

When material is returned to us under circumstances over which we have no control there will be a re-stocking charge of not less than 10% of the net selling price.

All shipments of material for repair or replacement must be sent with carrying charges prepaid.

Similar valves are available, on special order, with 250 lbs./sq. in. pressure capacity (static and differential). These valves, in either bronze or cast steel with Monel trim (metal disc only), are available only in sizes ¾" to 3" and with fYBa operators. Bronze, Monel or Stainless Steel discs are lapped at specified pressures and temperatures for tightness.

Pilot Piston valves are regularly supplied with tapered metal discs, which should always be used for steam and gas service. Renewable composition discs are suitable for service on water and some other liquids and are available on order.

The valves described on this data sheet are part of the Barber-Colman Electric System of Temperature and Humidity Control. Other units for which similar information is available include:

Thermostats, all kinds
Hygrostats
Packless Radiator Valves
Single Seat Packed Valves
Semi-Balanced Packed Valves
Full-Balanced Packed Valves
Throttling Valves
Three-way Valves
Solenoid Valves
Butterfly Valves
Damper Control Motors, Positive or Reversing

BARBER-COLMAN COMPANY
Rockford, Illinois

Barber-Colman control equipment is listed as standard by the Underwriters' Laboratories

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Disc	Sizes	Type
Bronze, Double, Vee-Ported	½", ¾", 1", 1¼", 1½", 2", 2½", 3", 3½", 4"	Semi-Balanced, Reversible

GENERAL DESCRIPTION

Patterns: Globe or angle, screwed or flanged ends. (Globe pattern furnished unless otherwise specified on order.)

Material: ½" to 3", bronze body and trim; 3" to 4", cast iron body with bronze trim.

Finish: ½" to 3", dull bronze; 3" to 4", black paint. cYBf operator enclosed in zinc alloy case, cYBc operator enclosed in steel case. All exposed steel parts zinc-cadmium plated.

Disc: Bronze, double, with vee-ported skirts for throttling.

Seat: Bronze, double.

Motor-Operator: Reversible type for regulating (throttling) service. Detachable as a unit.

Operation: **cYBf:** Reversible Barcol shaded pole induction motor drives plunger cam by reduction gearing (see drawings). Cam raises and lowers plunger by two-roller follower, opening and closing valve. Pressure of disc on seat when closed is imposed by spring in plunger yoke assembly. Motor may be stopped, then restarted in original direction or reversed, thus holding valve at any intermediate position, or opening or closing it the amount required for the proper throttling adjustment. Motor unit enclosed in oil-filled die cast meral case. External speed adjustment provided. Automatic cam-operated switches govern accurate stopping at ends of stroke. Auxiliary switches relay indication of position to successive apparatus.

The **cYBc** operators used on the larger valves (2" to 4") are larger, more rugged and slower than cYBf—note illustration and specifications. Principles of operation the same, construction noticeably different.

Tightness: In ordinary service these vee-ported double disc valves are better than 98% tight on steam. The most satisfactory service can be obtained from a double disc valve when the disc and seat are lapped at the temperature of use. Unless otherwise specified, the lap temperature of these valves will be that of 75 lbs. saturated steam.

Control: Three-wire low-voltage thermostat, single-pole double-throw switch, or equivalent.

Installation: Will operate properly in any position.

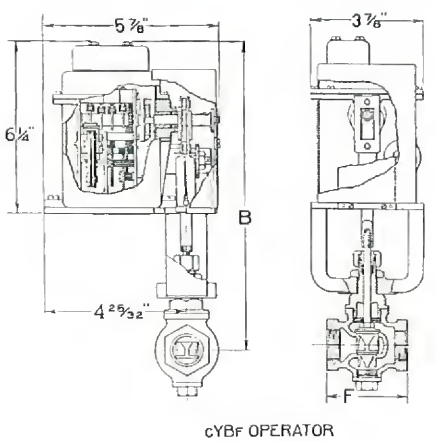
Power Requirements: 25 volt, 60 cycle, AC. Motor-operators for other voltages and frequencies on special order. Change in rated voltage does not alter characteristics of operator. Change in rated frequency alters speed in relation of new frequency to 60 cycles per second, but not in direct ratio. Units for 25 cycle service have approximately ¼ the no-load speed of 60 cycle units.

Microvalve: All reversing operators can be ordered as Microvalves by adding the suffix -M to the part number. For example, cYBf 350-M.

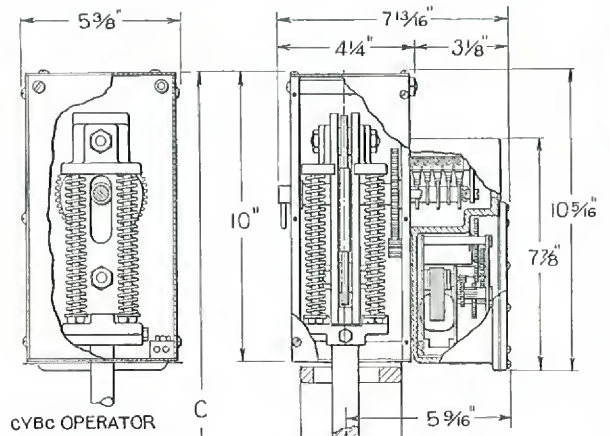
If the Microvalve is to be used in a reversing series combination with other Micro units, add the suffix R. For example, cYBf 354-MR.

Note: Valve Operator must be selected with auxiliary switches arranged for reversing series.

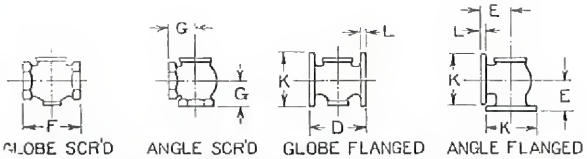
DIMENSIONS



cYBf OPERATOR



cYBc OPERATOR



GLOBE SCR'D ANGLE SCR'D GLOBE FLANGED ANGLE FLANGED

NOM. SIZE	B	C		D		E		F		G		K	L		M	N	O
		BRZ	C.I.	BRZ	C.I.	BRZ	C.I.	BRZ	C.I.	BRZ	C.I.		BRZ	C.I.			
½	10.81			3.00		2.13		2.50		1.13		3.00	.31		3/8	4	2.13
¾	11.13			3.13		2.38		2.75		1.38		3.50	.34		3/8	4	2.50
1	11.50			3.75		2.62		3.38		1.75		4.25	.38		½	4	3.13
1¼	11.75			4.38		2.94		4.00		2.00		4.62	.41		½	4	3.50
1½	11.75			4.88		3.19		4.50		2.25		5.00	.44		½	4	3.88
2		17.81		6.00	7.25	3.75		5.38	6.75	2.75		6.00	.50	.63	5/8	4	4.75
2½		18.25		6.75	8.50	4.25		6.38	7.88	3.25		7.00	.56	.69	5/8	4	5.50
3		18.88	22.32	7.50	8.75	4.56	4.75	7.13	8.75	3.63	4.38	7.50	.63	.75	5/8	4	6.00
3½			23.06		9.63		5.25		9.63		4.88	8.50		.81	5/8	8	7.00
4			23.19		10.88		5.50		10.88		5.50	9.00		.94	5/8	8	7.50

N = NO. OF BOLTS
M = SIZE OF BOLTS

BOLT HOLES STRADDLE CENTERLINE

Type	Sizes	Disc
Semi-Balanced, Reversible	½", ¾", 1", 1¼", 1½", 2", 2½", 3", 3½", 4"	Bronze, Double, Vee-Ported

Uses: Vee-ported skirts on the double bronze disc are designed so that the flow of steam or gas will be nearly proportional to the amount of opening of the valve.

Semi-balanced vee-ported valves are especially suited for work where throttling is to be obtained under the direct control of a thermostat and where close regulation is required. Instances of this are found in both heating and process work. For example, on a blast system where there is no by-pass damper on the steam coils, a valve on this type on the coil will provide closely graduated throttling regulation under the control of a single duct thermostat. In process work, where a tank or kettle is heated by a steam jacket or steam coil, and the liquid in it is to be closely controlled as to temperature, a valve of this type on the steam supply, controlled by a suitable thermostat, will provide good regulation.

These valves are suited for use where it is necessary to operate against pressures higher than can be handled by single seat valves, and where tight shut-off is not required on these valves.

All motor operated valves may be controlled either automatically by thermostats, hygrostats, relays, time-switches, etc., or by manually operated switches from a remote point.

SPECIFICATIONS

Item	Size, In.	Type	Material		Pressure, Lbs./Sq. In.		Aprx. Lift, In.	Service	Type	Input				Shading Coil Current Amps.	Average Sec./Stroke	Std. Operator Part No.
										Running		Idle				
			Body	Trim	Static	Diff.				Amps.	Watts	Amps.	Watts			
111	½	Semi-balanced	Bronze	Bronze	125	125	7/32	98% S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 350
112	¾	Semi-balanced	Bronze	Bronze	125	125	11/32	98% S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 351
113	1	Semi-balanced	Bronze	Bronze	125	125	15/32	98% S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 352
114	1¼	Semi-balanced	Bronze	Bronze	125	125	9/16	98% S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 353
115	1½	Semi-balanced	Bronze	Bronze	125	125	9/16	98% S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 353
116	2	Semi-balanced	Bronze	Bronze	125	125	7/8	98% S&R	Rev.	2.8	35	2.8	22	.50	275–2750	cYBc 468
117	2½	Semi-balanced	Bronze	Bronze	125	125	7/8	98% S&R	Rev.	2.8	35	2.8	22	.50	275–2750	cYBc 468
118	3	Semi-balanced	Bronze	Bronze	125	125	1 3/8	98% S&R	Rev.	2.8	35	2.8	22	.50	275–2750	cYBc 478
122	3	Semi-balanced	C.I.	Bronze	125	125	1 3/8	98% S&R	Rev.	2.8	35	2.8	22	.50	275–2750	cYBc 478
123	3½	Semi-balanced	C.I.	Bronze	125	125	1 3/8	98% S&R	Rev.	2.8	35	2.8	22	.50	275–2750	cYBc 478
124	4	Semi-balanced	C.I.	Bronze	125	125	1 3/8	98% S&R	Rev.	2.8	35	2.8	22	.50	275–2750	cYBc 478

EXPLANATION OF TABLE

Item: This number is for cross-reference to other data lists.

Size: Nominal pipe size.

Type: Brief description for general classification.

Material: "Trim" includes seat, disc, and stem.

Pressure: Static pressure applies to valve body; differential pressure is that against which valve will close tightly.

Approx. Lift: Distance disc is raised off seat in open position.

Service: "S" shut-off; "R" regulating (throttling). "98%" means valve not guaranteed to close tightly, but will stop at least 98% of full open flow in shut-off service.

Motor Type: Reversible.

Input: Principal electrical data of motor-operator.

Shading Coil Current: Is current which must be carried by thermostat or other control switch used with reversing valve.

Average Sec./Stroke: Time required to run from open to closed, or vice versa. More than one number, as 100-1000, means operator has speed adjustable between 100 and 1000 sec./stroke.

Std. Operator Part No.: This one furnished unless special requirements make it unsuitable. Large variety of auxiliary switching arrangements available.

NOTE: GLOBE PATTERN VALVES SHIPPED ON ALL ORDERS UNLESS OTHERWISE SPECIFIED.

The valves described on this data sheet are part of the Barber-Colman Electric System of Temperature and Humidity Control. Other units for which similar information is available include:

Thermostats, all kinds
Hygrostats
Packless Radiator Valves
Single Seat Packed Valves
Semi-Balanced Packed Valves
Full-Balanced Packed Valves
Throttling Valves
Three-way Valves
Solenoid Valves
Butterfly Valves
Damper Control Motors, Positive or Reversing

BARBER-COLMAN COMPANY
Rockford, Illinois

RETURNED MATERIAL

When material is returned to us under circumstances over which we have no control, there will be a re-stocking charge of not less than 10% of the net selling price.

Barber-Colman control equipment is listed as standard by the Underwriters' Laboratories.

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Disc	Sizes	Type
Bronze	¼", ½", ¾", 1", 1¼", 1½", 2", 2½", 3", 3½", 4"	Three-way, Double Seat, Pos. & Rev.

GENERAL DESCRIPTION

Pattern: Tee; ¼" to 2", screwed ends; 2½" to 4", screwed or flanged ends.

Material: ¼" to 2", bronze body and trim; 2½" to 4", cast iron body with bronze trim.

Finish: ¼" to 2", dull bronze, ground hexes; 2½" to 4", black paint. YBa operator has bakelite or zinc alloy cover; cYBf operator enclosed in zinc alloy case, cYBc operator in steel case. All exposed steel parts zinc-cadmium plated.

Disc: Bronze.

Seats: Double, Bronze.

Motor-Operator: Positive type for shut-off service. Reversing type for regulating (mixing) service. Detachable as a unit.

Operation: Positive Type YBa: Unidirectional Barcol shaded pole induction motor drives plunger cam by reduction gearing (see illustrations). Cam raises and lowers plunger by two-roller follower, moving the disc from one seat to the other. Pressure on disc when closed either way imposed by springs in plunger assembly. Automatic cam-operated switches govern accurate stopping at ends of stroke. Auxiliary switches relay indication of position to successive apparatus. Motor-operator stops only at open and closed positions.

cYBc operators used on the larger valves (items 144 to 147) are larger, more powerful, and slower. Principle of operation the same, construction noticeably different (see illustration).

Operation: Throttling Type cYBf and cYBc: Same general method, except *reversible* type motor. Motor unit enclosed in oil-filled die cast metal case. External speed adjustment provided. Motor-operator will stop and hold valve at any intermediate position, opening or closing further as required.

Control: Three wire low-voltage thermostat, single-pole double-throw switch, or equivalent.

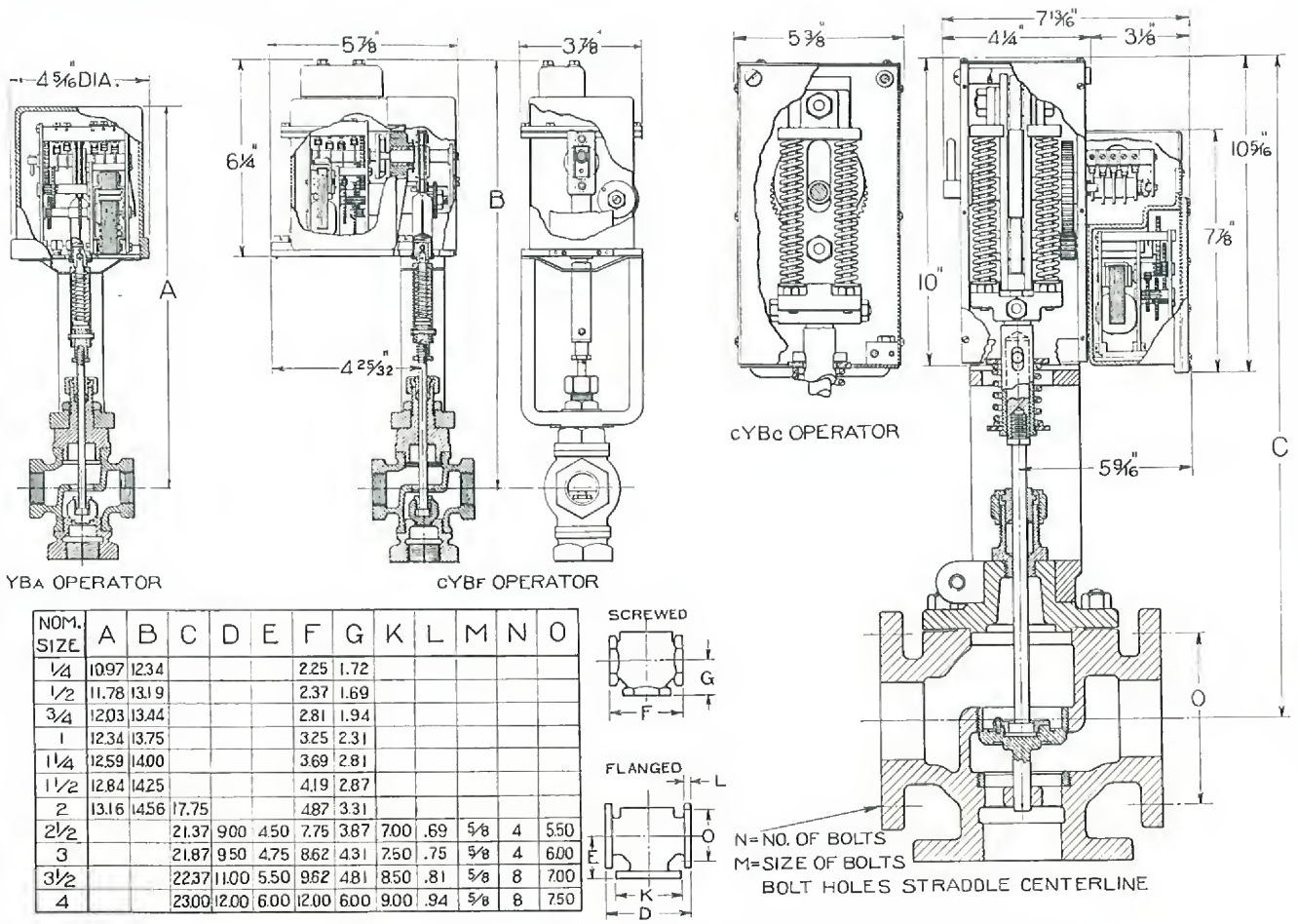
Installation: Will operate properly in any position.

Power Requirements: 25 volt, 60 cycle AC. Motor-operators for other voltages and frequencies on special order. Change in rated voltage does not alter characteristics of operator. Change in rated frequency alters speed in relation of new frequency to 60 cycles per second, but not in direct ratio. Units for 25 cycle service have approximately ¼ the no-load speed of 60 cycle units.

Microvalve: All reversing operators can be ordered as Microvalves by adding the suffix -M to the part number. For example, cYBf 350-M.

If the Microvalve is to be used in a reversing series combination with other Micro units, add the suffix R. For example, cYBf 354-MR. Note—Valve Operator must be selected with auxiliary switches arranged for reversing series.

DIMENSIONS



NOM. SIZE	A	B	C	D	E	F	G	K	L	M	N	O
¼	10.97	12.34				2.25	1.72					
½	11.78	13.19				2.37	1.69					
¾	12.03	13.44				2.81	1.94					
1	12.34	13.75				3.25	2.31					
1¼	12.59	14.00				3.69	2.81					
1½	12.84	14.25				4.19	2.87					
2	13.16	14.56	17.75			4.87	3.31					
2½			21.37	9.00	4.50	7.75	3.87	7.00	.69	5/8	4	5.50
3			21.87	9.50	4.75	8.62	4.31	7.50	.75	5/8	4	6.00
3½			22.37	11.00	5.50	9.62	4.81	8.50	.81	5/8	8	7.00
4			23.00	12.00	6.00	12.00	6.00	9.00	.94	5/8	8	7.50

Type	Sizes	Disc
Three-way, Double Seat, Pos. & Rev.	¼", ½", ¾", 1", 1¼", 1½", 2", 2½", 3", 3½", 4"	Bronze

Uses: This type of valve may be used either as a switch or as a mixing valve. When used as a switch, it has one inlet and two outlets; as a mixing valve, there are two inlets and one outlet. The pressure capacity depends on the type of service. In switching, the differential pressure is in general the pressure in the inlet line; in mixing, it is the difference between the pressures in the inlet lines (which is generally near zero) making the capacity limited only by the static pressure capacity of the body.

A three-way mixing valve is often necessary in air conditioning apparatus to maintain the temperature of the air being passed through a washer or cooling chamber by governing the respective amounts of cool and warm water that are fed to the sprays. This service is much the same as that performed by mixing dampers on the air ducts, where a proper mixture of cool and heated air is to be maintained automatically. Control is by a thermostat located in the cooling chamber or in the outlet from it.

One example of the use of a three-way valve as a switch is as a control for a large reducing valve. A small three-way valve under thermostatic control determines whether high pressure or low pressure steam shall be admitted under the diaphragm. When high pressure steam is admitted, the reducing valve closes and acts as a shut-off valve. When low pressure steam is admitted, the reducing valve operates normally, supplying steam to the system at the required pressure.

In general, valves of this type are useful in any water, steam, gas, oil, or other fluid applications where mixing or switching is required and there are not more than two inlets or outlets.

SPECIFICATIONS

Item	Size, In.	Type	Material		Pressure, Lbs./Sq. In.		Approx. Lift, In.	Service	Motor Type	Input				Shading Coil Current, Amps.	Average Sec./Stroke	Std. Operator Part No.
										Running		Idle				
			Body	Trim	Static	Diff.				Amps.	Watts	Amps.	Watts			
130	¼	Three-Way	Bronze	Bronze	125	125	⅛	S	Pos.	2.0	25	.....	.....	.....	20	YBa 422
131	½	Three-Way	Bronze	Bronze	125	125	5/16	S	Pos.	2.0	25	.....	.....	.....	20	YBa 430
132	¾	Three-Way	Bronze	Bronze	125	100	5/16	S	Pos.	2.0	25	.....	.....	.....	20	YBa 430
133	1	Three-Way	Bronze	Bronze	125	70	⅜	S	Pos.	2.0	25	.....	.....	.....	20	YBa 430
134	1¼	Three-Way	Bronze	Bronze	125	40	½	S	Pos.	2.0	25	.....	.....	.....	20	YBa 420
135	1½	Three-Way	Bronze	Bronze	125	25	½	S	Pos.	2.0	25	.....	.....	.....	20	YBa 420
136	2	Three-Way	Bronze	Bronze	125	10	½	S	Pos.	2.0	25	.....	.....	.....	20	YBa 420
144	2½	Three-Way	C.I.	Bronze	125	50	⅞	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 450
145	3	Three-Way	C.I.	Bronze	125	35	1⅛	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 454
146	3½	Three-Way	C.I.	Bronze	125	25	1¼	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 454
147	4	Three-Way	C.I.	Bronze	125	18	1¼	S	Pos.	2.3	30	.....	.....	.....	75	cYBc 454
137	¼	Three-Way	Bronze	Bronze	125	125	⅛	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 350
138	½	Three-Way	Bronze	Bronze	125	125	5/16	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 352
139	¾	Three-Way	Bronze	Bronze	125	100	5/16	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 352
140	1	Three-Way	Bronze	Bronze	125	70	⅜	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 352
141	1¼	Three-Way	Bronze	Bronze	125	40	½	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 353
142	1½	Three-Way	Bronze	Bronze	125	25	½	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 353
143	2	Three-Way	Bronze	Bronze	125	10	½	S&R	Rev.	1.6	20	1.5	17	.35	100–1000	cYBf 353
148	2½	Three-Way	C.I.	Bronze	125	50	⅞	S&R	Rev.	2.8	35	2.8	22	.50	275	cYBc 460
149	3	Three-Way	C.I.	Bronze	125	35	1⅛	S&R	Rev.	2.8	35	2.8	22	.50	275	cYBc 474
150	3½	Three-Way	C.I.	Bronze	125	25	1¼	S&R	Rev.	2.8	35	2.8	22	.50	275	cYBc 474
151	4	Three-Way	C.I.	Bronze	125	18	1¼	S&R	Rev.	2.8	35	2.8	22	.50	275	cYBc 474

EXPLANATION OF TABLE

Item: This number is for cross-reference to other data lists.

Size: Nominal pipe size.

Type: Brief description for general classification.

Material: "Trim" includes seat, disc, and stem.

Pressure: Static pressure applies to valve body; differential pressure is that against which valve will close tightly.

Approx. Lift: Distance traveled by disc between seats.

Service: "S" shut-off; "R" regulating.

Motor Type: Whether positive (unidirectional) or reversible.

Input: Principal electrical data of motor-operator.

Shading Coil Current: Applies only to reversible motor. Is current which must be carried by thermostat or other control switch used with reversing valve.

Average Sec./Stroke: Time required to run from one seat to the other. More than one number, as 100-1000, means operator has speed adjustable between 100 and 1000 sec./stroke. Type cYBc operators also available with external speed adjustment, both positive and reversing, minimum time (shown) being about 1/10 of maximum.

Std. Operator Part No.: This one furnished unless special requirements make it unsuitable. Large variety of auxiliary switching arrangements available.

The valves described on this data sheet are part of the Barber-Colman Electric System of Temperature and Humidity Control. Other units for which similar information is available include:

Thermostats, all kinds
Hygrostats
Packless Radiator Valves
Single Seat Packed Valves
Semi-Balanced Packed Valves
Full-Balanced Packed Valves
Throttling Valves
Solenoid Valves
Butterfly Valves
Damper Control Motors, Positive or Reversing

BARBER-COLMAN COMPANY
Rockford, Illinois

RETURNED MATERIAL

When material is returned to us under circumstances over which we have no control, there wil be a re-stocking charge of not less than 10% of the net selling price.

Barber-Colman control equipment is listed as standard by the Underwriters' Laboratories

Barber-Colman Company
ROCKFORD, ILLINOIS, U. S. A.

Disc	Sizes	Types
Renewable Composition and Stainless Steel	¼", ⅜", ½", ¾"	Single Seat & Pilot Piston

GENERAL DESCRIPTION

Pattern: Globe, ¼" to ¾", screwed ends. Angle, ½" and ¾", screwed ends. (Globe pattern furnished unless otherwise specified on order.)

Material: Brass body with bronze, brass, or stainless steel trim. Solenoid cover, cast iron. Armature stainless iron.

Finish: Body, bYBs and kYBs, zinc plated, dYBs, dull brass. Solenoid cover, black crinkle lacquer.

Disc: bYDs and dYBs, composition, water type standard; kYBs, metal. May be replaced without removing body of valve from line.

Seat: bYBs, bronze, renewable; dYBs, formed in brass body; kYBs, stainless steel, renewable.

Solenoid: Spool-wound coil of double-enameled copper wire, properly impregnated and insulated, is retained in cast-iron case by steel washer which forms part of magnetic circuit. Hole in top of case (below conduit threads) is sealed with standard black sealing compound. Stainless-iron armature moves in seamless copper alloy tube clamped into valve body. Complete solenoid assembly is outside this tube and may be replaced without removing valve from line.

Armature: Floating type (no mechanical stop). Hexagonal form fits snugly in tube to minimize hum, the narrow bearing surface serving to reduce danger of sticking. Armature is immersed in fluid or gas being handled. There are no packing glands because no moving parts protrude.

Operation: Single Seat: When current is applied to solenoid coil, the armature is drawn into coil, carrying disc-holder and disc with it, and opening valve. When current is shut off, armature is released and drops, closing valve. The higher the differential pressure, the more firmly the disc is forced against the seat. Line pressure must be on top side of disc.

Operation: Pilot Piston: Armature operates a small pilot valve on a by-pass through disc-holder. When current is applied to solenoid, pilot valve opens first and releases high pressure above disc-holder. Pressure differential against bottom of disc-holder opens valve and solenoid lifts complete assembly. Valve closes by gravity when current is shut off and is held closed by pressure differential on top of disc-holder, as in Single Seat valve above. Line pressure comes into body on top side of seat.

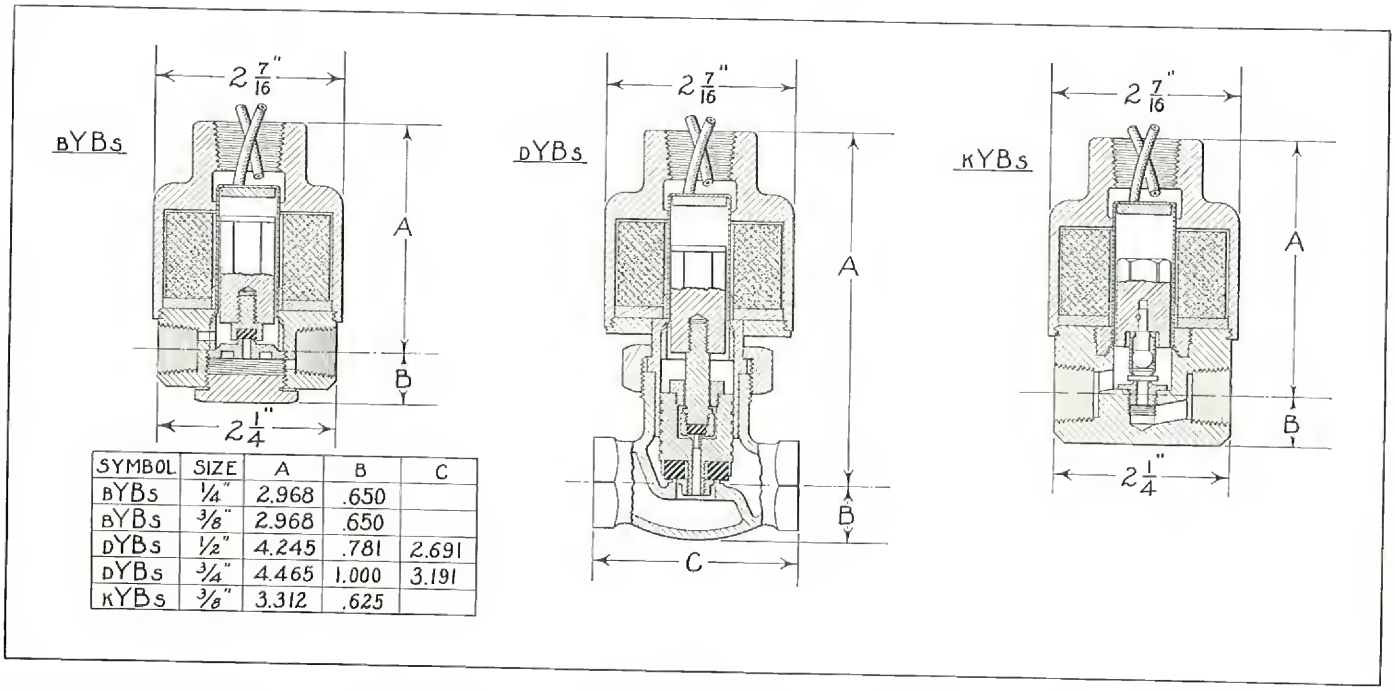
Control: Two-wire thermostat (or two wires from a three-wire thermostat), single-pole single-throw switch or equivalent. Note: Thermostats should be ordered with jumper to by-pass current around bimetal element.

Position: For use in upright position only. Solenoid must be on top because valve is closed by gravity.

Power Requirements: 115 or 25-volt, 60-cycle, AC. Can be made for other voltages and frequencies, and for direct current, on special order.

Note: Do not use solenoid valves on fluids, the temperature of which exceeds 150F.

DIMENSIONS



SYMBOL	SIZE	A	B	C
bYBs	¼"	2.968	.650	
bYBs	⅜"	2.968	.650	
dYBs	½"	4.245	.781	2.691
dYBs	¾"	4.465	1.000	3.191
kYBs	⅜"	3.312	.625	

Types	Sizes	Disc
Single Seat & Pilot Piston	¼", ⅜", ½", ¾"	Renewable Composition and Stainless Steel

Uses: Solenoid valves are used where a quick-opening and quick-closing valve is required. With the proper disc, they will handle water, oil, brine, air, illuminating gas, refrigerants, and other liquids and gases which will not attack the materials of the valve. There are many applications, such as humidifiers, air conditioners, refrigeration machines, domestic gas furnaces, industrial gas service applications, etc., where valves of this type are needed.

SPECIFICATIONS

Item	Size, In.	Type	Material			Pressure, Lbs./Sq.In.		Port Dia., In.	Use	Input			Frequency, Cycles
			Body	Trim	Disc	Static	Diff.			Volts	Amps.	Watts	
bYBs 701	¼	Single Seat	Brass	Bronze	Comp.	150	100	3/32	Gas & Water	115	0.2	12	60
bYBs 702	¼	Single Seat	Brass	Bronze	Comp.	150	100	3/32	Gas & Water	25	0.9	12	60
bYBs 703	⅜	Single Seat	Brass	Bronze	Comp.	150	100	3/32	Gas & Water	115	0.2	12	60
bYBs 704	⅜	Single Seat	Brass	Bronze	Comp.	150	100	3/32	Gas & Water	25	0.9	12	60
bYBs 705	¼	Single Seat	Brass	Bronze	Comp.	150	15	¼	Gas & Water	115	0.2	12	60
bYBs 706	¼	Single Seat	Brass	Bronze	Comp.	150	15	¼	Gas & Water	25	0.9	12	60
bYBs 707	⅜	Single Seat	Brass	Bronze	Comp.	150	15	¼	Gas & Water	115	0.2	12	60
bYBs 708	⅜	Single Seat	Brass	Bronze	Comp.	150	15	¼	Gas & Water	25	0.9	12	60
dYBs 721	½	Pilot Piston	Brass	Brass	Comp.	150	100	½	Gas & Water	115	0.2	12	60
dYBs 722	½	Pilot Piston	Brass	Brass	Comp.	150	100	½	Gas & Water	25	0.9	12	60
dYBs 723	¾	Pilot Piston	Brass	Brass	Comp.	150	100	¾	Gas & Water	115	0.2	12	60
dYBs 724	¾	Pilot Piston	Brass	Brass	Comp.	150	100	¾	Gas & Water	25	0.9	12	60
kYBs 811	⅜	Single Seat	Brass	St. Steel	Metal	150	150	5/32	Freon	115	0.2	12	60
kYBs 812	⅜	Single Seat	Brass	St. Steel	Metal	150	150	5/32	Freon	25	0.9	12	60

EXPLANATION OF TABLE

Item: This number is for cross-reference to other data lists.

Size: Nominal pipe size.

Type: Brief description for general classification.

Material: "Body" includes part of valve into which the pipes are fitted. "Trim" includes seat only. "Disc" includes pilot and main discs.

Pressure: Static pressure is capacity of valve body. Differential pressure is that against which valve will open positively.

Port Dia.: Size of hole under disc through which fluid flows.

Use: Service for which valve is designed.

Input: Principal electrical data of solenoid.

Frequency: Of alternating current supplied.

NOTE: GLOBE PATTERN VALVES SHIPPED ON ALL ORDERS UNLESS OTHERWISE SPECIFIED.

RETURNED MATERIAL

When material is returned to us under circumstances over which we have no control, there will be a re-stocking charge of not less than 10% of the net selling price.

All shipments of material for repair or replacement must be sent with carrying charges prepaid.

The valves described on this data sheet are part of the Barber-Colman Electric System of Temperature and Humidity Control. Other units for which similar information is available include:

Thermostats, all kinds
Hygrostats
Packless Radiator Valves
Single Seat Packed Valves
Semi-Balanced Packed Valves
Full-Balanced Packed Valves
Throttling Valves
Three-way Valves
Butterfly Valves
Damper Control Motors, Positive or Reversing

BARBER-COLMAN COMPANY
Rockford, Illinois

Barber-Colman control equipment is listed as standard by the Underwriters' Laboratories.

BARBER-COLMAN COMPANY

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